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Fossils from the Miura Peninsula and its Immediate North.

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With 19 Plates and 1 Map.

Introduction.

The peninsula of Miura which bounds the Uraga Strait, the entrance to Tokyo Bay, on the west and is a little over 20 kilometres from north to south and 4 to 12 kilometres from east to west is, geographically speaking, a low hilly country rarely attaining a height over 200 metres above the level of the sea.[1]

This hilly country gradually diminishes in height towards the north, and not far south of Yokohama, passes into the great plain of Tokyo, the most extensive and also one of the most populous in the whole empire, but which, until some five centuries ago, was in greater part a wilderness known under the name of *Musashino*[2] and with but a sparse population.

Geologically, the hilly peninsula as well as the plain is made up of very young formations which are in part undoubtedly Pliocene and in part either Pliocene or Pleistocene.

1) There are only three peaks which are over 200 m. in height. They are Ōgusuyama (242 m.), Futagoyama (228 m.) and Hatakeyama (208 m.).

2) From *Musashi*, the name of the province in which the plain is situated, and *No*, a grass-grown, uncultivated field.

The formation which constitutes the plain[1] is divisible into two quite distinct series, the upper which is subaerial, and the lower which is marine. The upper or subaerial series is made up of a brown loam, an altered volcanic ash, wholly devoid of stratification and of organic remains, extending in the south as far as beyond Sugita, a sea-side village about 8 kilometres south of Yokohama. The thickness varies according to places, but may attain up to 6 metres.

The lower or marine series is several hundred metres in thickness.[2] It consists of repeated alternations of different kinds of terrigenous rocks such as clays, sands and gravels which in the lower portion of the series change into shales, sandstones and conglomerates. These rocks are everywhere more or less tufaceous, that is to say, containing materials ejected from volcanoes, but at the same time very rich in organic remains, which are mostly Mollusca, but sometimes plants, worms, echinoderms, mammals, etc. Among the mammals, an elephant called *Elephas namadicus* Falc. et Caut. first described from the Narbada bed of India[3] is perhaps the most important.

The strata of this marine series are quite or nearly horizontal in the plain, though inclined and tilted in the peninsula. Brauns,[4] who studied these layers some thirty-nine years ago, believed the presence of a line of unconformability mostly due to the denudation of the layer-surface, not only between the loam and the marine series, but also in the uppermost part of the latter itself. And as he took the shell-layers found just below this lower so-called line of unconformability for *Pliocene*, he called all the layers lying above it *Diluvial*, whereby the loam received the name of *Upper*

1) The geology of the plain is found in the works of Edmund Naumann (das jetzige Tokio, Peterm. Geogr. Mitteil., 1879, vol. 25) and David Brauns (Geology of the Environs of Tokio, Mem. Sci. Departm., Univ. Tokio, No. 4, 1881).

2) A boring was once driven in Tokyo to depth of over 400 metres without reaching the bottom of the formation (Report of the Earthquake Investigating Committee, No. 45, Tokyo. Japanese).

3) Taken by many European authors for Pleistocene, while Osborn of America considers it to be Upper Pliocene (Age of Mammals, p. 355).

4) Geology of the Environs of Tokio before cited, p. 6.

Diluvial and the clays, sands and gravels immediately below it that of *Lower Diluvial.*

Tokunaga,[1] who examined these layers much later and more extensively than Brauns, denies the presence of the lower line of unconformability altogether, und moreover considers the shell layers which Brauns believed to be *Pliocene* as *Diluvial* or *Pleistocene.* As far as the above said lower line of unconformability is concerned, I am of the same opinion as Tokunaga. But as regards the upper one to which Tokunaga makes no reference, I perfectly concur with Brauns, only with this modification that the line is often not only indistinct, but entirely absent, the loam and the underlying marine beds being perfectly conformable with each other. And this is, I believe, due to the deposition of loam having taken place soon after the elevation of the marine beds above the sea; in that case, we may assume that the surface of the newly risen land in many places had not been sufficiently gnawed by water previous to the deposition of loam so as to give rise to the so-called line of unconformability. And such places we have reason to expect most numerous near the sea-side and also in the littoral regions. In fact, the loam is often underlaid by clayey layers somewhat different in colour from it. These, I believe, are nothing more than the same loam which has deposited in places where there was more or less water.

The marine series being very thick and containing fossils almost throughout are probably divisible into many horizons. But such divisions being at present impossible owing to the lack of materials, I divide the whole series into only two parts, the *upper* and the *lower.* The *upper part* is represented by the strata exposed in the plain, including the shell layers of Oji, Tabata, Shinagawa, etc., places lying in the immediate neighbourhood of Tokyo. Remains of *Elephas namadicus* are not uncommon in this

1) Fossils from the Environs of Tokyo (Journ. Coll. Sci., Imp. Univ. Tokyo, 1906, Vol. XXI, Art. 2) p. 92.

part. The *lower part* is typically developed in the peninsula of Miura. Here again the Mollusca form the most important fossil, though in one place, Yokosuka a lower jaw of *Elephas namadicus*[1] has also been discovered.

The position of the line of demarcation between the two parts is at present uncertain, for, geologically, the whole marine series is a single complex of layers conformably superposed one upon another, and palaeontologically, the fossils found in the intermediate place have not yet been fully examined. But, if that line should ever be drawn, I think it will be somewhere near Yokohama, perhaps a little south of it. Be the position as it may, it is quite evident that the layers exposed in the Miura Peninsula occupy a lower position than those of the plain, for the latter which are nearly horizontal in the neighbourhood of Tokyo gradually dip to north as we proceed southward, and already at Sugita, Naganuma, etc., the angle is about 5°. And southward from these places the angle grows slowly but constantly, so that near Yokosuka it is already 20° to 30°, while in the southern half of the Miura Peninsula, the layers after making several folds finally dip south with very steep angles.[2]

Concerning the geological age of the upper part of the marine series, opinions are divided. Brauns, as before mentioned, pronounced it to be *Pliocene*, while Tokunaga, Yabe[3] and others consider it to be *Pleistocene*. As to myself, I am not able at present to forward any opinion on it, as I have not yet thoroughly studied its fossil contents.[4] Under such circumstances, I deem it most expedient not to call the formation by age, that is to say,

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1) E. Naumann. Über die fossilen Elephanten der Vorzeit. Palaeotographica Bd. XXVIII, Heft 1, 1881, p. 28.

2) About the geology of the peninsula, see S. Yoshiwara's Tokyo Inan Miura Hanto Chishitsu Ron (Geology of South of Tokyo and of the Miura Peninsula), Jour. Geol. Soc. Tokyo, 1902, Vol. IX.

3) H. Yabe. A New Pleistocene Fauna from Tokyo. Geol. Mag., Dec. V, Vol. VIII, London, 1911.

4) The treatment of these fossils will appear in a future paper.

the Pliocene formation or the Pleistocene formation, as has often hitherto been done, but by some name which has no relation to it. On this account, I here propose the name of *Musashino Formation* for the whole marine series. Then its upper part will be the *Upper Musashino* and its lower part the *Lower Musashino*. The fossils described below are those of the latter.

General Remarks on the Mollusca of the Lower Musashino.

The fossils which form the subject of the present paper, though partly collected by Dr. Tokunaga and myself, were to a greater part brought together by the late Gordon Yamakawa[1] who showed great zeal in the study of palaeontology, but who unfortunately died in 1910, while still a student in the university of Tokyo.

The localities in which the fossils were found are twenty-eight in number. These I provisionally group into six zones which, beginning from above, are as follows:

1. *Nagauma Zone.*—Comprising four localities: Naganuma, Sugita, Iijima and Kikkōsan.

2. *Koshiba Zone.*—Comprising two localities: Koshiba and Ofuna.

3. *Kanazawa Zone.*—Comprising three localities: Kanazawa, Teramae and Nojima.

4. *Kamakura Zone.*—Comprising four localities: Kamakura, Kewaizaka, Uragō and a place between Uragō and Enokido.

5. *Yokosuka Zone.*—Comprising three localities: Yokosuka, Otsu and a place between Shioiri and Sakamoto.

6. *Miyata Zone.*—Comprising, besides Motowada and Nagai, five localities (Mukōbatake, Iwaiguchi, Jinya-ato, Matsubara-no-

1) Several, though short, papers were written by this lamented youth on the fossils of the Upper Musashino. They appeared in the Journal of the Geological Society of Tokyo, the most important being those on Opisthobranchiata and on Pteropoda.

Subkingdom Mollusca. **Class Gastropoda.** Order Opisthobranchiata. *Family Tornatinid æ.*	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagaoma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
1. Retusa minima Yamakawa.	+					+	+		
2. Volvula acuminata Bruguière.		+					+	Pliocene of Sicily.	Atlantic Ocean ; Suez.
Family Scaphandrid æ.									
3. Cylichna musashiensis Tokunaga.					+		+		
4. Cylichna braunsi Yokoyama.						+			
5. Cylichna sibaensis Yamakawa.	+					+	+		
6. Cylichna yamakawai Yokoyama.		+					+		
7. Cylichna orientalis Yokoyama.					+				
Family Ringiculid æ.									
8. Ringicula musashinoensis Yokoyama.	+	+				+	+		Central Japan.
Order Prosobranchiata. *Family Terebrid æ.*									
9. Terebra lischkeana Dunker.	+						+		Central Japan.
10. Terebra recticostata Yokoyama.						+	+		
11. Terebra naumanni Yokoyama.						+			
12. Terebra tokunagai Yokoyama.						+			
Family Conid æ.									
13. Conus sieboldi Reeve.					+				Central Japan ; China.
14. Conus tuberculatus Yokoyama.	+				+				
Family Pleurotomid æ.									
15. Pleurotoma kamakurana Pilsbry.				+	+				Central Japan.
16. Pleurotoma mediocarinata Yokoyama.				+					

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagananma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
17. Pleurotoma (Drillia) principalis Pilsbry.					+	+	+		Northern, Central, and Western Japan.
18. Pleurotoma (Drillia) pseudo-principalis Yokoyama.		+				+			
19. Pleurotoma (Drillia) quantoana Yokoyama.						+	+		
20. Pleurotoma (Drillia) cosibensis Yokoyama.					+				
21. Pleurotoma (Drillia) nivalioides Yoko ama.					+	+	+		
22. Pleurotoma (Drillia) benten Yokoyama.						+			
23. Pleurotoma (Drillia) braunsi Yokoyama.					+	+			
24. Pleurotoma (Mangilia) deshayesii Dunker.					+		+		Western Japan.
25. Pleurotoma (Mangilia) miyatensis Yokoyama.	+								
26. Pleurotoma (Surcula?) nojimensis Yokoyama.				+					
27. Pleurotoma (Bela?) glabra Yokoyama.					+				
Family Cancellariidæ.									
28. Cancellaria spengleriana Deshayes.		+				+	+		Central Japan; Philippines; Australia.
29. Admete viridula (Fabricius).					+			Pliocene of England and Belgium.	Circumboreal; Sakhalin.
Family Volutidæ.									
30. Voluta megaspra Sowerby.	+		+	+	+	+	+		Northern, Central, and Western Japan.
Family Mitridæ.									
31. Mitra ebenus Lamarck.					+			Pliocene and Miocene of Europe.	Atlantic; Mediterranean.
32. Mitra fusiformis Brocchi.					+			Pliocene and Miocene of Europe.	
33. Mitra plicifera Yokoyama.					+				

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagamma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
34. Mitra (Costellaria) emmæ Yokoyama.	+								
Family Fasciolariidæ.									
35. Fusus niponicus Smith.	+				+		+		Central Japan.
36. Fusus perplexus A. Adams.						+	+		Northern, Central, and Western Japan.
Family Buccinidæ.									
37. Chrysodomus phoeniceus Dall.				+	+	+			British Columbia; Japan?
38. Chrysodomus schrenecki Yokoyama.				+	+	+			
39. Sipho obesiformis Yokoyama.						+			
40. Siphonalia dilatata Quoy.	+								Japan (Adams); New Zealand.
41. Siphonalia spadicea Reeve.	+	+				+	+		Central Japan.
42. Siphonalia trochulus Reeve.						+	+		Central Japan.
43. Siphonalia fuscolineata Reeve.						+			Western Japan.
44. Siphonalia stearnsii Pilsbry.						+			Japan (Pilsbry), south of 36th parallel.
45. Buccinum leucostoma Lischke.				+					Central Japan.
46. Volutharpa perryi Jay.	+						+		Northern and Central Japan.
Family Nassidæ.									
47. Nassa (Hima) japonica Adams.		+					+		Central and Western Japan.
48. Nassa (Hima) festiva Powis.	+					+	+		Northern, Central and Western Japan.
49. Nassa (Niotha) livescens Philippi.	+	+				+	+		Central and Western Japan; Indian Ocean.
Family Columbellidæ.									
50. Columbella (Mitrella) dunkeri Tr.	+	+					+		Northern, Central, and Western Japan.
51. Columbella (Atilia) burchardi Dkr.	+	+					+		Japan (Dunker).
Family Muricidæ.									
52. Trophon subclavatus Yokoyama.	+						+		

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagannma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
53. Trophon nipponicus Yokoyama.				+	+				
54. Trophon muricatoides Yokoyama.	+								
55. Trophon inermis Sowerby.		+		+	+				Japan (Sowerby).
56. Purpura luteostoma Chemnitz.		+							North., Centr., West. Japan ; Africa.
57. Purpura alveolata Reeve.		+				+			Central and Western Japan ; Chile ; Panama.
Family Tritonid .									
58. Triton (Priene) oregonensis Redfield.			+	+	+		+		Northern Japan ; Alaska ; Strait of Magellan.
59. Triton subpyrum Yokoyama.						+			
Family Doliid .									
60. Dolium luteostomum Küster.	+	+				+	+		Northern, Central, and Western Japan Indian Ocean.
Family Cerithiid .									
61. Cerithium kobelti Dunker.		+							Central Japan.
62. Bittium perpusillum Tryon.		+							Western Japan.
63. Bittium binodulosum Yokoyama.					+				
64. Potamides (Tympanotonos) fluviatilis Potiez et Michaud.		+					+		Central Japan ; Australia.
65. Potamides (Batillaria) multiformis Lischke.		+					+		Northern, Central, and Western Japan.
Family Cerithiopsiid .									
66. Triforis otsuensis Yokoyama.		+					+		Central Japan.
Family Trichotropiid .									
67. Trichotropis planicostata Yokoyama.					+				
Family Vermetid .									
68. Thylacodes medusæ Pilsbry.	+	+					+		Central Japan.

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Naganuma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
Family Turritellidæ.									
69. Turritella nipponica Yokoyama.	+			+	+	+			
Family Solariidæ.									
70. Solarium lenticulatum Yokoyama.					+				
Family Rissoidæ.									
71. Rissoina submercurialis Yokoyama.		+							
72. Rissoina zeltnerioides Yokoyama.		+							
73. Fenella orientalis Yokoyama.		+					+		Central Japan.
Family Skeneidæ.									
74. Skenea nipponica Yokoyama.		+							Central Japan.
Family Capulidæ.									
75. Calyptræa mamillaris Broderip.	+						+		West Coast of America from Puget Sound to Strait of Magellan.
76. Crepidula orbella Yokoyama.						+			
Family Naticidæ.									
77. Natica janthostoma Deshayes.	+	+	+	+	+	+	+		Northern and Central Japan; Kamchatka.
78. Polinices pallidus Broderip et Sowerby.					+				Circumpolar; Okhotsk Sea.
79. Polinices (Neverita) ampla Philippi.	+	+				+	+		Central Japan; China; Indian Ocean.
Family Scalariidæ.									
80. Scalaria turriculoides Yokoyama.					+				
81. Scalaria (Acrilla) densicostata Yokoyama.					+		+		
Family Eulimidæ.									
82. Eulima (Leiostraca) yokoskensis Yokoyama.		+							

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Naganuma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
83. Eulima (Leiostraca) sagamiana Yokoyama.						+			
Family Pyramidellidæ.									
84. Pyramidella (Tiberia) pseudopulchella Yokoyama.		+				+			
85. Odostomia hilgendorffi Clessin.						+			Northern Japan.
86. Odostomia takinogawensis Tokunaga.						+	+		
87. Odostomia sublimpida Yokoyama.	+					?	+		
88. Turbonilla (Cingulina) adamsi Yokoyama.						+			
89. Turbonilla (Chemnitzia) subapproximata Yokoyama.						+			
90. Turbonilla (Mormula) tokunagai Yokoyama.		+							
Family Turbinidæ.									
91. Turbo (Marmorostoma) coreensis Recluz.		+							Central and Western Japan.
92. Leptothyra amussitata Gould.	+	+			+		+		Northern Japan ; Sakhalin.
93. Leptothyra purpurescens Dunker.	+						+		Japan (Dunker).
94. Leptothyra cf. paucicostata Dall.		+							Dall's species lives in California.
Family Trochidæ.									
95. Chlorostoma miyatense Yokoyama.	+								
96. Chlorostoma quantoanum Yokoyama.		+							
97. Chlorostoma tokunagai Yokoyama.		+							
98. Cantharides japonicus A. Adams.	+	+							Central and Western Japan.
99. Bembix crumpii Pilsbry.			+	+	+				Japan (Crump).
100. Bembix convexiusculum Yokoyama.			+	+					

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Naganuma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
101. Margarita umbilicalis Broderip et Sowerby.			+						Polar Seas (Greenland, etc.)
102. Margarita cinerea Couthony.	+								Behring Sea ; North Atlantic.
103. Turcica imperialis A. Adams.	+						+		Northern, Central, and Western Japan.
104. Calliostoma cipangoanum Yokoyama.		+							
105. Calliostoma sagamianum Yokoyama.						+			
106. Euchelus fenestratus Yokoyama.		+							
107. Umbonium giganteum Lesson.						+			Central and Western Japan.
108. Umbonium costatum Valenciennes.						+	+		Northern, Central and Western Japan.
Family Cyclostrematidæ.									
109. Cyclostrema duplicatum Lischke.		+							Central Japan.
Family Fissurellidæ.									
110. Macroschisma sinensis A. Adams.		+					+		Central Japan ; Singapore.
111. Fissuridea cf. tanneri Verrill.					+				Verrill's species lives in east coast of America at 100–142 fathoms.
112. Puncturella subconica Yokoyama.					+				
113. Emarginula fragilis Yokoyama.	+								
114. Emarginula sp.					+				
Family Acmæidæ.									
115. Acmæa heroldi Dunker.	+								Central and Western Japan.
116. Acmæa kuragiensis Yokoyama.					+				
117. Acmæa nojimensis Yokoyama.				+					
Family Patellidæ.									
118. Helcioniscus pallidus Gould.	+				+		+		Northern and Central Japan.

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagahama Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
Class Scaphopoda.									
Family Dentaliidæ.									
119. Dentalium complexum Dall.			+	+	+	+			Central Japan ; Sandwich I. (300 ft).
120. Dentalium weinkauffi Dunker.	+			+	+	+	+		Central Japan.
121. Dentalium octogonum Lamarck.	+	+				+	+		Northern Japan to Ceylon.
122. Dentalium edoense Tokunaga.	+	+				+	+		Central and Western Japan.
123. Cadulus gordonis Yokoyama.	+					+			
Class Lamellibranchiata.									
Family Pholadidæ.									
124. Pholas fragilis Sowerby.		+					+		Western Japan ; Philippines.
125. Jouannetia japonica Yokoyama.		+							
Family Saxicavidæ.									
126. Saxicava orientalis Yokoyama.		+					?		
Family Pholadomyidæ.									
127. Pholadomya japonica Yokoyama.						+			
Family Corbulidæ.									
128. Corbula venusta Gould.	+	+			+	+	+		Northern Japan.
129. Basterotia gouldi A. Adams.		+							Western Japan.
130. Basterotia trapezium Yokoyama.		+							
Family Mesodesmatidæ.									
131. Ervilia otsuensis Yokoyama.		+							
Family Mactridæ.									
132. Mactra veneriformis Deshayes.		+					+		Central and Western Japan ; Northern China.

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagatuma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
133. Lutraria radiata Yokoyama.						+			
Family Solenidæ.									
134. Solen gordonis Yokoyama.	+								Western Japan.
135. Solecurtus abbreviatus Gould.						+			Central Japan ; Hong kong.
136. Solecurtus divaricatus Lischke.		+					+		Central and Western Japan.
Family Tellinidæ.									
137. Tellina nitidula Dunker.	+					+	+		Central and Western Japan.
138. Tellina ojiensis Tokunaga.	+						+		Northern Japan.
139. Tellina vestalioides Yokoyama.						+			Northern Japan.
140. Tellina serricostata Tokunaga.	+					+	+		
141. Tellina miyatensis Yokoyama.	+						+		
142. Macoma dissimilis Martens.	+	+					+		Central Japan.
143. Macoma inquinata Deshayes.	+	+					+		Northern, Central, Western Japan. Okhotsk Sea. Alaska to San Diego.
144. Macoma nipponica Tokunaga.	+						+		Northern Japan.
Family Veneridæ.									
145. Dosinia troscheli Lischke.	+					+	+		Central and Western Japan.
146. Cyclina chinensis Deshayes.		+					+		Northern Japan to Cochin China.
147. Meretrix (Callista) chinensis Chemnitz.						+	+		Northern Japan ; China ; Australia.
148. Venus jedoensis Lischke.	+	+					+		Central and Western Japan.
149. Chione isabellina Deshayes.						+	+		Japan (Deshayes) ; China.
150. Chione minuta Yokoyama.						+			
151. Circe scripta Linné.						+			Central and Western Japan ; Red Sea.
152. Venerupis irus Linné.		+						Pliocene of Europe.	Central Japan ; Mediterranean Sea.
153. Venerupis insignis Deshayes.		+							Central Japan ; New Zealand.

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagamma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
154. Tapes variegatus Hanley.	+								Central and Western Japan; Philippines.
155. Tapes philippinarum Reeve.		+					+		Northern Japan to Indian Ocean.
156. Tapes amabilis Philippi.						+			Central and Western Japan.
157. Saxidomus purpuratus Sowerby.		+					+		Northern to Western Japan; West Coast of America; Indian Ocean.
Family Cardiidæ.									
158. Cardium californiense Deshayes.	+	+					+		Northern, Central, Western Japan; Behring Sea; California.
159. Cardium muticum Reeve.		+				+	+		Northern Japan to Philippines; East Indies.
160. Cardium modestum Adams et Reeve.					+		+		Central Japan.
161. Cardium braunsi Tokunaga.	+						+		
Family Diplodontidæ.									
162. Diplodonta usta Gould.	+						+		Northern and Central Japan.
163. Diplodonta semiaspera Philippi.	+				+		+		Central and Western Japan; West Indies; Patagonia.
164. Diplodonta japonica Pilsbry.						+	+		Central Japan.
165. Diplodonta gouldi Yokoyama.	+								Central Japan.
Family Lucinidæ.									
166. Lucina pisidium Dunker.	+	+				+	+		Northern to Southern Japan; Australia.
167. Lucina borealis Linné.	+	+				+	+	Miocene and Pliocene of Europe	Central Japan; Atlantic; Mediterranean.
168. Lucina contraria Dunker.	+						+		Central Japan.
169. Lucina spectabilis Yokoyama.					+				
170. Lucina yamakawai Yokoyama.	+								
Family Chamidæ.									
171. Chama semipurpurata Lischke.	+	+					?		Central and Western Japan.
Family Carditidæ.									
172. Cardita variegata Bruguière.	+								Central Japan.

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagamuma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
173. Cardita cummingiana Dunker.	c	+							Central and Western Japan.
174. Venericardia cipangoana Yokoyama.	+					+	+		Central and Western Japan.
175. Venericardia ferruginea Adams.	+	+		+	+	+	+		Northern Japan.
Family Astartidæ.									
176. Astarte hakodatensis Yokoyama.	+				+	+	+		Northern Japan.
177. Woodia concentrica Yokoyama.						+			
Family Crassatellidæ.									
178. Crassatella heteroglypta Pilsbry.	+					+			Central and Western Japan.
179. Crassatella oblongata Yokoyama.	+				+				
Family Myochamidæ.									
180. Myodora reeviana Smith.	+				+		+		Western Japan ; China.
181. Myodora triangularis Adams.						+			Japan (Adams).
Family Mytilidæ.									
182. Mytilus hirsutus Lamarck.	+	+							Central and Western Japan.
183. Mytilus giganteus Holmberg.		+							Northern, Central, Western Japan ; Alaska.
184. Modiola modiolus Linné.	+						+	Pliocene of Europe.	Northern, Central and Western Japan ; North Pacific ; North Atlantic.
Family Anomiidæ.									
185. Anomia cytaeum Gray.	+	+			+	+			Northern and Central Japan ; Mouth of the Yangtsekiang.
186. Anomia nipponensis Yokoyama.	+	+				+	+		Northern, Central and Western Japan.
Family Limidæ.									
187. Lima goliath Smith.	+				+				Central Japan (400–750 fathoms) ; Patagonia.

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Naganuma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
188. Lima zushiensis Yokoyama.		+							
189. Lima angulata Sowerby.						+	+		Northern Japan to Philippines; Panama, etc.
190. Lima japonica Adams.				+	+		+		Northern and Central Japan; New Zealand.
191. Lima subauriculata Montagu.	+						+	Miocene and Pliocene of Europe.	Greenland to Mediterranean.
192. Lima quantoensis Yokoyama.					+		+		Central Japan.
Family Pectinidæ.									
193. Pecten squamatus Gmelin.						+			Central Japan to Philippines.
194. Pecten lætus Gould.	+	+				+	+		Northern, Central, and Western Japan.
195. Pecten crassicostatus Sowerby.						+			Central Japan to Hongkong.
196. Pecten irregularis Sowerby.	+	+			+		+		Central Japan; East Indies.
197. Pecten vesiculosus Dunker.					+		+		Central Japan.
198. Pecten swiftii Bernardi.					+				Northern Japan; Okhotsk and Behring Seas.
199. Pecten tigerrinus Müller.					+			Pliocene of Europe.	Atlantic (Norway to France).
200. Pecten cosibensis Yokoyama.					+				
201. Pecten intuscostatus Yokoyama.	+				+		+		
202. Pecten miurensis Yokoyama.	+	+							
203. Pecten tokunagai Yokoyama.					+				
204. Pecten tokyoensis Tokunaga.	+	+				+	+		
205. Pecten yessoensis Jay.	+		+	+	+		+		Northern Japan; Okhotsk Sea.
206. Pecten laqueatus Sowerby.	+	+					+		Northern, Central, and Western Japan.
207. Pecten naganumana Yokoyama.						+			

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Nagaruma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
Family Ostreidæ.									
208. Ostrea gigas Thunberg.		+			+		+		Northern, Central, Western Japan; Shantung in China.
209. Ostrea denselamellosa Lischke.		+					+		Central to Southern Japan (Ryukyu).
210. Ostrea plicata Chemnitz.		+							Western Japan; East Indies.
211. Ostrea musashiana Yokoyama.					+		+		
Family Arcidæ.									
212. Arca kobeltiana Pilsbry.	+	+		+	+		+		Northern and Central Japan.
213. Arca decussata Sowerby.					+				Western Japan; Philippines; Indian Ocean.
214. Arca stearnsii Pilsbry.					+				Central Japan.
215. Arca symmetrica Reeve.		+				+	+		Central Japan to Philippines; Indian Ocean.
216. Arca inflata Reeve.						+	+		Northern Japan to Philippines.
217. Pectunculus rotundus Dunker.	+					+	+		Central Japan.
218. Pectunculus jessoensis Sowerby.	+						+		Northern Japan.
219. Pectunculus nipponicus Yokoyama.	+			+	+				Central Japan.
220. Pectunculus pilsbryi Yokoyama.	+						+		Central Japan.
Family Parallelodontidæ.									
221. Parallelodon obliquatus Yokoyama.	+	+			+		+		Northern and Central Japan.
Family Limopsidæ.									
222. Limopsis auritoides Yokoyama.				+					
223. Limopsis tōkaiensis Yokoyama.	+		+	+	+	+			Central Japan.
224. Limopsis crenata A. Adams.	+		+	+	+		+		Northern and Central Japan.

	Miyata Zone.	Yokosuka Zone.	Kamakura Zone.	Kanazawa Zone.	Koshiba Zone.	Naganuma Zone.	Upper Musashino.	Fossil in foreign countries.	Living.
225. Limopsis azumana Yokoyama.	+				+		+		
226. Limopsis adamsiana Yokoyama.	+				+		+		
Family Ledidæ.									
227. Leda ramsayi Smith.	+				+		+		New South Wales at 950 fathoms.
228. Leda gordonis Yokoyama.						+			
229. Leda naganumana Yokoyama.						+			
Family Nuculidæ.									
230. Nucula insignis A. Adams.					+		+		Northern Japan.
231. Nucula mirabilis Adams et Reeve.				+		+	+		Central and Western Japan.
232. Nucula tōkyoensis Yokoyama.	+					+			
Subkingdom Molluscoidea.									
Class Brachiopoda.									
Family Terebratulidæ.									
233. Terebratulina crossii Davidson.				+	+	+			Central and Western Japan (100-200).
234. Terebratulina caput-serpentis Linné.	+				+			Miocene and Pliocene of Europe.	Japan (Davidson); North Pacific; North Atlantic; Mediterranean Sea.
235. Terebratulina quantoensis Yokoyama.					+				
236. Terebratella coreanica Adams et Reeve.	+								Northern, Central, and Western Japan.
237. Terebratella pulvinata Gould.	+						+		Puget Sound, Washington.
238. Terebratella nipponensis Yokoyama.					+				

Fuchi and Yamagayado) in Kami-Miyata and four localities (Maruyama-no-Saka, Harashita, Matsubara and Motoyashiki) in Shimo-Miyata.

The number of species collected in the above-named places amounts to 238 in all, as will be seen from the foregoing table:

A glance at the table is sufficient to show that we have here a fauna which has lived in a shallow sea. The lithological character of the fossil-bearing rock in some places also points to the same conclusion, for example, as at Koshiba where it is partly a conglomerate.

Among the species above enumerated, there are 3 which are not well determined. But, even if we deduct these 3, there still remain 235 species, a number which, I believe, is enough to give quite a fair idea of the general character of the entire fauna.

In the first place, what is very important in the fauna from the geological point of view is the percentage of the extinct forms against the living. The number of those forms which are hitherto not known to be living amounts to 88 species or about 37% of the whole fauna. This is a percentage which is considerably greater than that ascertained in the Mollusca of the Upper Musashino.[1] And among the living, there are still 7 species which have not yet been found in Japanese waters. They are the following:

1. *Volvula acuminata* (Brug.). Habitat: Suez, Atlantic.

2. *Mitra ebenus* Lam. Habitat: Atlantic (incl. Mediterranean).

3. *Calyptraea mamillaris* Brod. Habitat: West Coast of America.

4. *Lima subauriculata* Mont. Habitat: Atlantic (Greenland to Mediterranean).

5. *Pecten tigerrinus* (Müll.). Habitat: Atlantic (Norway to France).

6. *Leda ramsayi* Smith. Habitat: New South Wales.

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1) Tokunaga in his "Fossils from the environs of Tokyo" p. 95 says that there are at least 10 extinct species among 165 which he enumerated, though I think the real number is somewhat greater.

7. *Terebratella pulvinata* Gould. Habitat: Puget Sound in Washington.

If we add these 7 to the above, the total number of forms not yet known as living either in the whole world or in the Japanese waters becomes 95 which is about 40% of the whole fauna. Naturally, there is a great possibility of future discoveries reducing these numbers. But as the Japanese Molluscan fauna is already pretty well known, a great reduction in them is hardly to be expected. I think, the above percentage will not fall far below one-third of the whole fauna, in which case the fauna is to be ascribed to the *Pliocene*, and not to its upper-most part but somewhat lower, somewhere near the Red Crag of Newbourne, England (Newbournian) which is considered as an equivalent of the Amstelien of the Netherlands.

A comparison of the Japanese fossil fauna with that of foreign countries is at present of little value, as the species in common are remarkably few. They are only the following:

1. *Volvula acuminata* (Brug.).—Pliocene of Europe.
2. *Admete viridula* (Fabr.).—Pliocene of Europe.
3. *Mitra ebenus* Lam.—Miocene and Pliocene of Europe.
4. *Mitra fusiformis* (Broc.).—Miocene and Pliocene of Europe.
5. *Triton oregonensis* Redf.—Pleistocene of California.
6. *Macoma inquinata* Desh.—Pliocene of California.
7. *Venerupis irus* L.—Pliocene of Europe.
8. *Lucina borealis* L.—Pliocene and Pleistocene of Europe.
9. *Modiola modiolus* L.—Pliocene of Europe.
10. *Lima subauriculata* Mont.—Miocene and Pliocene of Europe.
11. *Pecten tigerrinus* Müll.—Pliocene of Europe.
12. *Terebratulina caput-serpentis* L.—Miocene and Pliocene of Europe.

And if *Natica clausa* Brod. et Sow. be really identical with *Natica janthostoma* Desh. as asserted by some, then as the former is found in the Pliocene and Pleistocene of California and the

latter in Japan, the whole number becomes 13, which is only 5,5% of the entire fauna.

Secondly, what is much more important than the comparison of the Japanese fossil fauna with the foreign is its decidedly more boreal character, when compared with the recent. If we divide the fossil species which are still found living, 148 in all, according to their habitat, the result is as follows:

(1) Species now living near the fossil localities (Central Japan) or in about the same latitudes (Western Japan) 54
Percentage of the whole fauna.....36.5

(2) Species now living in Central and Western Japan as well as north of it (Northern Japan) 34
Percentage of the whole fauna.....23.0

(3) Species now living in Northern, Central, and Western Japan as well as south of it (Southern Japan) ...33
Percentage of the whole fauna.....22.3

(4) Species now living only in foreign countries and in seas cooler as well as warmer than that of Central Japan 5
Percentage of the whole fauna..... 3.4

(5) Species now living only in Northern Japan, or if foreign, in seas cooler than that of Central Japan 20
Percentage of the whole fauna.. .....13.5

(6) Species now known only as deep-sea forms 2
Percentage of the whole fauna..... 1.3

It is noteworthly that, while there are many species which now only live *north* of the fossil localities, there is not a single one which lives exclusively *south* of them. These northern or boreal species are the following:

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1) Japan is here divided into four parts, viz: Northern, Central, Western, and Southern Japan. By Northern Japan is meant that part of the country lying north of the 38th parallel. Central Japan is the part situated south of the above parallel and east of the 136th meridian. Western Japan is the part west of the same meridian, including Chugoku, Shikoku and Kyushu, while Southern Japan includes all the islands lying south of Kyushu, that is to say, the Seven Islands, the Ryukyus and Formosa.

1. *Admete viridula* (Fabr.).—Habitat: Sakhalin; circumboreal.

2. *Chrysodomus phœniceus* Dall.—Habitat: British Columbia.

3. *Triton oregonensis* Redf.—Habitat: Northern Japan, Alaska, Strait of Magellan.

4. *Pollinices pallidus* Brod. et Sow.—Habitat: Okhotsk Sea; circumpolar.

5. *Odostomia hilgendorffi* Clessin.—Habitat: Northern Japan.

6. *Leptothyra amussitata* Gould.—Habitat: Northern Japan, Sakhalin.

7. *Margarita umbilicalis* Brod. et Sow.—Habitat: Polar Seas.

8. *Margarita cinerea* Couth.—Habitat: Behring Sea, North Atlantic.

9. *Corbula venusta* Gould.—Habitat: Northern Japan.

10. *Tellina ojiensis* Tok.—Habitat: Northern Japan.

11. *Tellina vestalioides* Yok.—Habitat: Northern Japan.

12. *Macoma nipponica* Tok.—Habitat: Northern Japan.

13. *Venericardia ferruginea* Adams.—Habitat: Northern Japan.

14. *Astarte hakodatensis* Yok.—Habitat: Northern Japan.

15. *Pecten swiftii* Bern.—Habitat: Northern Japan, Okhotsk and Behring Seas.

16. *Pecten yessoensis* Jay.—Habitat: Northern Japan, Okhotsk Sea.

17. *Pectunculus yessoensis* Sow.—Habitat: Northern Japan.

18. *Nucula insignis* Adams.—Habitat: Northern Japan.

19. *Terebratella pulvinata* Dall.—Habitat: Puget Sound (Washington).

Besides these northern forms, there are two which are now known as deep-sea forms. They are *Lima goliath* Sm. living near Central Japan, but at a depth of 400–750 fathoms and also in Patagonia, and *Leda ramsayi* Sm. which has been found living near New South Wales at a depth of 950 fathoms.

There is also a species among those described as new which is hardly distinguishable from the one now living in the circumpolar seas, and that is *Trophon subclavatus*.

From what has been stated above, it can not be doubted that during the deposition of the Lower Musashino the waters near the Miura Peninsula were much colder than they are at the present time, a condition similar to that ascertained by R. Arnold in the Upper Pliocene of California.[1)]

Lastly, if we look at the respective zones into which the whole fauna has been divided, the percentage of the extinct as well as of the boreal forms against the total number of species found in each of them is as follows:

Name of Zones.	No. of Spec. found.	No. of Extinct Sp. and Percentage.	No. of Boreal Sp. and Percentage.
Naganuma	86	33 or 38,3%	6 or 6,9%
Koshiba	74	30 or 40,5%	13 or 17,5%
Kanazawa	27	8 ———	4 ———
Kamakura	10	1 ———	3 ———
Yokosuka	80	20 or 25,0%	3 or 3,7%
Miyata	96	25 or 26,0%	13 or 13,5%

Leaving aside the two zones of Kanazawa and Kamakura which have yielded only a small number of fossils, the percentage of the extinct as well as of the boreal forms in the four other zones is subject to a considerable change, a change in which no regularity can be found. But so much is true that the percentage of both forms is greatest in the Koshiba Zone. Therefore, if this is not a chance, I should infer that the cold waters which washed the shores of the Pacific side of Central Japan during the Lower Musashino had its greatest effect on the fauna of the Koshiba Zone, or in other words, the waters were coldest at that time. Of course, whether this was true or not, future studies can alone decide.

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1) R. Arnold. Palæontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California (Mem. Calif. Acad. Sci., vol. III, 1903) p. 65.

It may not be quite out of place here to say a few words on the remains of the Pleistocene glaciers which, in 1911 I said, were entirely wanting in Japan.[1] Soon after that, a German geographer, Dr. A. Hettner, came to Japan and during his trip to the so-called Japanese Alps in Shinano asserted that he had discovered glacial scratches on blocks of stone found in the valley of the Azusagawa. On hearing this, several of our scientists went to see them, and one of them was rash enough to say that they are undoubtedly glacial scratches and that the only question is when they were made. Subsequently, however, the late Tetsunosuke Kato went to the place, made a careful research, and declared the so-called glacial scratches to have been caused during a landslide. I myself have not yet had an opportunity to examine them, but so much I can say now that even if those scratches be due to the action of ice, I see no need of modifying my previous assertion above alluded to, for, during the Pliocene time, when colder waters flowed near Central Japan than now, the Japanese Alps which even at present are snow-clad during the greater part of the year, if they were then high enough, would most likely have formed glaciers whose remains we should still see in many parts of the mountains. Such glaciers, however, glaciers in the sense of those of the great Ice-age of the West, according to my own opinion, did not exist, or else the scratches would be more widely distributed and not restricted to any single valley. Moreover, if glaciers were present, there must be also smoothed rocks, erratic blocks, boulder-clays, etc., which in the once ice-covered regions of Europe and America are very widely spread and can hardly escape the eyes even of a casual observer. From these considerations I deem the opinion of Kato as more probable, inasmuch as landslides are of frequent occurrence in Shinano.

I shall recur to the question of the climate of the past geological ages in future papers on the fossils of the Upper Musashino and of the still younger formations which I intend to publish as soon as circumstances will permit.

1) Climatic Changes in Japan since the Pliocene Epoch, p. 3. Journ. Coll. Sci., Imp. Univ. Tokyo, 1911, Vol. XXXII. Art. 5.

DESCRIPTION OF THE SPECIES.

Subkingdom **Mollusca.**

Class **Gastropoda.**

Order **Opisthobranchiata.**

Family **Tornatinidæ.**

Genus ***Retusa***, Brown.

1. **Retusa minima**, Yamakawa.

Pl. I. Fig. 1.

Retusa minima. Yamakawa, Descript. of Some Foss. Opisthobranchiata fr. Diluv. Dep. of Japan, Jour. Geol. Soc. Tokyo, vol. XVIII, No. 212, May, 1911, p. 47, pl. XI, figs. 21–24.

We possess two specimens which can be identified with the above-named species which Yamakawa characterized as follows:—

"Shell small, thin, cylindrical, somewhat compressed in the middle; upper end depressed, concave, retuse, with a plicated nucleus in the centre of the bottom; lower end obtuse; suture deep; whorls four, flattened; surface smooth, only with many fine obtuse longitudinal growth-lines; aperture as long as the shell, narrow, linear, with the lower one-third abruptly expanded; pillar-lip with an obtuse fold; outer lip curved forward in the middle. Height 3 millim. Diam. 1,5 millim."

One of our specimens measures 2,5 millim. in length and 1,2 millim. in thickness; while the other measures 2 millim. in length and 1 millim. in thickness.

Fossil occurrence:—Miyata Zone (Okine in Nagai); Naganuma Zone (Naganuma); Upper Musashino of Musashi, Shimosa and Kazusa.

Genus ***Volvula***, A. Adams.

2. **Volvula acuminata**, (Bruguière).

Pl. I. Fig. 2.

Volvula acuminata. Tryon. Man. Conch., vol. XV, p. 236, pl. XXVI, figs. 61, 62, pl. LX, fig. 11 (var. brevis).

Volvula acuta. Tokunaga, Foss. Env. Tokyo, p. 32, pl. II, fig. 13.

Bulla acuminata. Bruguière, Encycl. Méth., I, p. 376. Philippi, Enum. Moll. Sicil., I, p. 122, pl. VII, fig. 1. Wood, Crag Moll. I, p. 174, pl. XXI, fig. 7.

Cylichna acuminata. Jeffreys, Brit. Moll. IV, p. 141, V, p. 222, pl. 93, fig. 1.

A single specimen of a small subfusiform shell, 3.5 millim. in height and 1.2 millim. in diameter, with acuminate apex and fine spiral lines at both ends. In form, it stands intermediate between the typical specimen of the species and its variety *brevis*, as figured by Tryon in his Manual of Conchology above cited. *Volvula acuta* Tokunaga from Oji is, as I am now convinced, identical with the Yokosuka-form, though somewhat less acute at apex (the figure given in Tokunaga's work represents the shell more cylindrical than it really is). Whether *Volvula oxytata* Bush (Tryon's Man., XV, p. 235, pl. 26, fig. 63) from the east coast of the United States is really different from the European *V. acuminata* is very doubtful; at least it comes quite close to the Japanese fossil.

Fossil occurrence in Japan:—Yokosuka Zone (Yokosuka); Upper Musashino of Musashi, Kazusa and Shimosa.

Fossil occurrence in Europe:—Pliocene of Italy; Crag of England and Belgium.

Living:—Atlantic, from Norway to Mediterranean; Suez.

Family **Scaphandridæ**.

Genus ***Cylichna***, Lovén.

3. **Cylichna musashiensis**, Tokunaga.

Pl. I. Fig. 4.

Cylichna musashiensis. Tokunaga, Foss. Envir. Tokyo, p. 32, pl. II, fig. 12.
Bulla cylindracea. Brauns, Geol. Env. Tokio, p. 35 (non Pennant).

Brauns, in describing the fossils from Oji in 1881, identified this species with the well known Atlantic form *Cylichna cylindracea* Pennant in which, however, Tokunaga subsequently recognized a new species not yet known to be living either in the Japanese waters or elsewhere. On carefully comparing specimens from the environs of Tokyo with the figures and descriptions given of *Cylichna cylindracea* Pennant, I also came to the conclusion that they are different from the Atlantic species on the following grounds: the shell is decidedly shorter (Tokunaga erroneously says "more elongated)," is not compressed in the

middle, and the expansion of the basal portion of the aperture is less. The apex, however, is sunken just as in *Cylichna cylindracea* and funnel-shaped with bottom closed and bounded by a rounded margin.

In a single specimen which was obtained at Koshiba, the lower portion of the aperture is broken; but its general shape leaves no doubt of its being identical with Tokunaga's species. The transverse striations which Tokunaga thought to be absent are present in ours, though mostly obliterated by friction, and are most distinctly preserved on the apical part. It measures 14 millim. in length (or height) and 6 millim. in diameter.

Fossil occurrence:—Koshiba Zone (Koshiba); Upper Musashino of Musashi, Kazusa and Shimosa.

4. **Cylichna braunsi**, Yokoyama.

Pl. I. Fig. 5.

Shell small, quite cylindrical, slightly tapering at both ends, truncate above, rounded below. Surface with fine impressed transverse lines which are coarser and more distinct near the upper and lower ends, especially near the upper. Aperture linear, dilated below into an ovate shape. Apex sunken into a small shallow pit. Columella lip somewhat callous.

Two specimens. One measures 9 millim. in height and 2,8 millim. in diameter; while the other measures 7 millim. by 2,5 millim.

Fossil occurrence:—Naganuma Zone (Naganuma).

5. **Cylichna sibaensis**, Yamakawa.

Pl. I. Fig. 6.

Cylichna sibaensis. Yamakawa, Descrip. Fossil Opisthobr. Japan, Journ. Geol. Soc. Tokyo, vol. XVIII, No. 212, May, 1911, p. 48, pl. XI, figs. 25–29.

This species is readily distinguishable from the foregoing forms by its conically ovoid shape and thin shell. The surface is ornamented with fine transverse striæ which Yamakawa mentions as occurring only in the anterior and posterior parts of the shell;

but in our specimens from Mukōbatake, (Kami-Miyata), they are also found in a region between, although so faint as to require a powerful lens and a good illumination to see them. YAMAKAWA mentions *Retusa phiala* A. ADAMS, *Retusa coelata* Bush, *Retusa ovata* JEFFR. and *Cylichna pyramidata* A. ADAMS among the recent species as more or less allied to the present one. The specimens are rather rare.

Fossil occurrence:—Miyata Zone (Mukōbatake in Kami-Miyata, and Nagai); Naganuma Zone (Naganuma); Upper Musashino of Musashi.

6. **Cylichna yamakawai,** YOKOYAMA.

PL. I. FIG. 7.

Bullinella striata. YAMAKAWA, Descript. Fossil Opisthobr. Japan, Journ. Geol. Soc. Tokyo, vol. XVIII, May, 1911, p. 51, pl. XI, figs. 37-38.

YAMAKAWA gives, the diagnosis of his *Bullinella striata* as follows:

"Shell small, thin, cylindrical, short, convolute, slightly compressed in the middle; anterior and posterior ends rounded; surface with obtuse lines of growth and transverse striations, the latter being very fine, rather distant and somewhat more indistinct in the anterior than in the posterior part of the shell; vertex neither depressed nor perforated; aperture entire, narrowed in the posterior portion, widened in the anterior, the widening beginning at two-fifths the length from the bottom; lip thin, straight behind, curved in front. Height 2,8 millim. Diameter 1,5 millim."

Of the two specimens obtained at Yokosuka, one measures nearly 3 millim. in length.

Fossil occurrence:—Yokosuka Zone (Yokosuka between Shioiri and Sakamoto); Upper Musashino of Shimo-Suyeyoshi and of Dokwanyama, both near Tokyo.

The specific name *striata* was changed into *Yamakawai*, as I do not recognize the distinction of *Bullinella* from *Cylichna*, in which case *striata* is a name already preoccupied by JEFFREYS (Ann. Mag. Nat. Hist. (4) XX. p. 492).

7. Cylichna orientalis, Yokoyama.

Pl. I. Fig. 9.

A small subcylindrical shell, 8 millim. in height and 3 millim. in diameter, slightly tapering both above and below. The linear aperture is dilated at the basal portion where it is considerably produced downward, ending in a blunt point. The columella is reflected outward and broad, with the outer lip thin. The surface is water-worn, but very finely transversely striated.

The living species which may be brought into comparison with the present one are *Cylichna concinna* A. Adams (Tryon, Man. Conch. XV, p. 309, pl. 59, fig. 10) from the Japanese waters and *Cylichna ordinaria* Smith (Tryon, p. 319, pl. 27, fig. 90) from Australia. But both have the basal portion of the aperture not so much produced, and besides, the former has a deep umbilicus. Rare.

Fossil occurrence:—Koshiba Zone (Koshiba).

Family Ringiculidæ.

Genus ***Ringicula***, Deshayes.

8. Ringicula musashinoensis, Yokoyama.

Pl. I. Figs. 3, 8.

Ringicula arctata. Brauns, Geol. Env. Tokio, p. 30, Tokunaga, Foss. Env. Tokyo, p. 32, pl. II, fig. 11.

Shell small, ovately globose, with apex acute. Whorls four, convex, very rapidly growing and spirally ornamented with fine impressed lines which number about seven on the penultimate and about ten on the ultimate whorl. These lines are often faint or invisible on rubbed specimens. Base rounded. Aperture elongated, longer than half the height of the shell, and anteriorly somewhat widened and notched. Posterior canal present. Columellar folds two, strong and prominent. Callus of the inner lip broad, half as long as the aperture and projecting into the latter as a broad triangular tooth. Outer lip thickened and swollen, running downward so that it is more or less parallel to the axis of the shell. Height 4 millim. Diameter 3 millim.

This is the shell described by Brauns and Tokunaga as *Ringicula arctata* Gould from which it differs in having a more rounded base. The closest ally of this species is probably *Ringicula doliaris* Gould which lives in Central Japan. But this latter species is said to have the outer lip thin. *Ringicula caron* Hinds (Tryon, Man. Conch., vol. XV, pl. 47, fig. 68) is also related to the present species; but the outer lip is corrugated in the former.

Fossil occurrence:—Miyata Zone (Shimo-Miyata and Nagai); Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma), frequent; Upper Musashino of Musashi, Shimosa and Kazusa.

Living:—Central Japan (Sagami Bay).

Order **Prosobranchiata.**

Family **Terebridæ.**

Genus ***Terebra***, Adanson.

9. Terebra lischkeana, Dunker.

Pl. I. Fig. 10.

Tere'ra lischkeana. Dunker, Index Moll. Maris Japon., p. 71, pl. V, figs. 13-16.

A single specimen. The shell is subulate, consisting of many flatly convex whorls ornamented with somewhat curved roof-shaped longitudinal riblets which turn their concave side towards the front and their upper end somewhat toward behind. The number of these riblets is about eighteen on the last whorl on the base of which they are obsolete. The interspaces are broadly V-shaped and ornamented with fine impressed transverse lines. On all the whorls there is a transverse groove at about one-third the height of the whorl from the upper suture. Canal short and recurved.

Our specimen lacks the apex and shows only twelve whorls, while perfect ones are said to have seventeen to eighteen. The diameter is 7 millim.; the height, if perfect, would be about 30 millim.

Fossil occurrence:—Miyata Zone (Kami-Miyata). Upper Musashino of Shimosa.

Living:—Central Japan (Sagami Bay).

10. **Terebra recticostata**, Yokoyama.

Pl. I. Fig. 11.

Shell subulate; whorls about twelve, of which the two uppermost are embryonal and smooth; the others are only slightly convex with a subsutural band of coarse tubercles numbering thirteen on the penultimate and fourteen on the ultimate whorl. Below these tubercles there are rounded vertical ribs just as many as the tubercles, separated from them by a wide though shallow transverse (spiral) groove in the bottom of which there is an impressed transverse (spiral) line more distinct in the upper than in the lower whorls. The ribs which become weak at the lower suture and almost obsolete on the base of the last whorl below the rounded periphery are separated from each other by a concave interspace which is more than double the breadth of the ribs. Growth-lines distinct. Aperture subrhombic. Canal short, bent. A short posterior canal is also present. Columella lip somewhat flattened and depressed with a median longitidudinal groove. Outer lip thin and sharp. A single specimen obtained measures 24 millim. in height and 6 millim. in diameter.

This species somewhat resembles *Terebra serotina* Ad. and Reeve (Voy. Samarang, p. 30, pl. X, fig. 12), but the ribs are less in number and the groove below the tubercular band broader.

Fossil occurrence:—Naganuma Zone (Naganuma). Upper Musashino of Shimosa.

11. **Terebra naumanni**, Yokoyama.

Pl. I. Fig. 12.

Shell subulate; whorls many, slightly concave, with two somewhat elevated sutural bands carrying tubercles, the one close to the upper suture and the other close to the lower. The two bands are unequal in breadth, the lower being nearly twice as

broad as the upper. The tubercles are mostly somewhat elongated longitudinally, equal in number in the two bands, but larger in the lower. Their number is about seventeen in the last whorl. Between the tubercular bands and connecting their tubercles, there are rounded vertical riblets, somewhat curved and turning their concave sides towards the front, quite fused with the upper tubercles, but separated from the lower ones by a fine sharp groove. The interspaces between the riblets are flat and wider than the latter. The riblets as well as the interspaces are coarsely, but closely, transversely striated, the striæ being subequal or unequal and commonly about six in number. The bands are also very finely striated in transverse direction. On the body-whorl, the periphery is formed by a row of tubercles somewhat smaller than those of the infra-sutural band, but equal in number to the latter. Below the periphery which may be called roundly angular, the surface is spirally threaded and crossed by weak longitudinal riblets which are the basal continuations of those found on the flanks of the shell.

Four specimens, none of which is perfect, being broken in the apertural as well as in the apical portion. The canal, however, is preserved; it is short and recurved. The number of whorls seems to have been about fifteen. One specimen measures 6,5 millim. in diameter; the height, if complete, would be about 30 millim.

Fossil occurrence.—Naganuma Zone (Naganuma).

12. **Terebra tokunagai,** Yokoyama.

Pl. I. Fig. 13.

Shell subulate; whorls many, somewhat concave, with two sutural bands of tubercles, the one upper or infrasutural and the other lower or suprasutural. The tubercles of the upper band are elongated longitudinally and also somewhat obliquely with the upper end directed forward, and are much larger than those of the lower band which are more roundish in shape, except on the last whorl in which they form the periphery; they are just as large as the others, and also somewhat obliquely elongated, though in an

opposite sense, turning their upper ends towards behind. The number of tubercles of the one band is nearly equal to that of the other and is about twenty-three on the last whorl; the interspaces between the tubercles are nearly equal in breadth to the latter. Between the upper and lower bands, the space is coarsely marked with growth-lines with a fine thread of small tubercles, often very faint, just below the upper band. Periphery bluntly angular. Base with coarse lines of growth and with a faint transverse groove bounding the peripheral tubercles from below. Canal short, bent sideward and then a little backward.

A single specimen with the upper end broken. The whorls preserved number ten, with length 23 millim. and diameter 5,5 millim. If the whorls were complete, the length would be about 30 millim.

Fossil occurrence.—Naganuma Zone (Naganuma).

Family **Conidæ.**

Genus ***Conus***, Linné.

13. **Conus sieboldi**, Reeve.

Pl. I. Fig. 14.

Conus sieboldi. Reeve, Conch. Icon., vol. I, suppl., pl. I, spec. 269. Sowerby, Thesaur. Conchyl., vol. III, p. 13, pl. 202, fig. 369. Dunker, Ind. Moll. Maris Japon., p. 93.

A single specimen, a little over 50 millim. in height and 23 millim. in diameter. Although the surface is much worn and the apical part of the spire is broken, the slender and longly conical shell with carinated shoulders and sunken whorls are too characteristic to be mistaken for any other species than that above mentioned. The transverse grooves at the lower part of the body-whorl number about six.

Fossil occurrence.—Koshiba Zone (Koshiba).

Living.—Central Japan; China.

14. **Conus tuberculatus**, Yokoyama.

Pl. I. Figs. 15, 16.

Shell small, elongate-conic; spire elevated, acute, slightly concave when seen sideways; whorls seven to eight, shouldered;

shoulders tuberculated, above which the surface is somewhat concave with fine spiral striæ and oblique lines of growth; on the body-whorl the tubercles are less distinct with the surface below it mostly smooth, the fine spiral grooves only appearing near the lower end. Aperture long and linear with the lower end somewhat truncate.

The specimens are not rare, but all more or less water-worn, on which account the tubercles are often indistinct. Fig. 15 shows a worn specimen, 17 millim. in height and 8 millim. in diameter. Fig. 16. is a better preserved specimen, measuring 14 millim. by 7 millim.

The related species are *Conus d'Orbignyi* Aud. (Tryon, Conch., vol. X, p. 75, pl. 23, fig. 96) from the Japanese and Chinese waters and *Conus antidiluvianus* Broc. (Hörnes, Moll. Wiener-Beckens, p. 138, pl. V, fig. 2) from the European Neogene, from which, however, our fossil is readily distinguishable by its shorter spire.

Fossil occurrence.—Miyata Zone (Kami-Miyata); Koshiba Zone (Koshiba).

Family **Pleurotomidæ.**

Genus ***Pleurotoma***, Lamarck.

15. Pleurotoma kamakurana, Pilsbry.

Pl. I. Fig. 17.

Pleurotoma ? kamakurana. Pilsbry, Cat. Mar. Moll. Japan, p. 16, pl. II, figs. 15, 16.

This shell is elongate-fusiform in shape, with the canal nearly as long as the spire; the whorls are very convex, almost angular, concave above and appressed at the suture. The sculpture consists of numerous short vertical folds and numerous subequal crowded spiral threads. The vertical folds on the body-whorl do not reach the level of the upper angle of the shell-aperture, becoming obsolete as they approach that level. The aperture is longly oval, passing below into a long, open, straight canal. Sinus wide and shallow; outer lip gently arched forward.

We possess two imperfect specimens, the larger of which is 12

millim. in diameter. It lacks, however, both apex and lower end of the canal, and also the outer lip.

Fossil occurrence.—Koshiba Zone (Koshiba); Kanazawa Zone (Nojima, Kanazawa, Teramae).

Living.—Central Japan.

16. **Pleurotoma mediocarinata,** Yokoyama.

Pl. I. Fig. 18.

Shell short-fusiform; spire moderately high, but shorter than body-whorl; whorls seven, the two uppermost ones being embryonal, smooth and convex, the others with an elevated rounded spiral keel in the middle representing the sinus-band; the surface above this keel is concave, below it flatly convex and vertical, both being ornamented with fine spiral threads. Lines of growth very coarse, especially on the keel, making it appear finely toothed. The body-whorl below the keel is broadly convex, forming a rounded periphery, and ornamented with numerous unequal spiral threads. Aperture longly rhombic, nearly half as long as the shell, pointed behind, narrowed in front passing into a short, somewhat curved canal. Inner lip smooth, with a thin callus spread over it. Outer lip thin, sharp, with a deep sinus at some distance from the impressed suture; the lip below the sinus is arched forward. Height 25 millim. Diameter 11 millim. Length of aperture together with canal 12 millim.

A single specimen, but well preserved. The high elevated rib-like sinus-band is very characteristic.

Fossil occurrence.—Kanazawa Zone (Nojima).

17. **Pleurotoma (Drillia) principalis** (Pilsbry).

Pl. I. Fig. 20.

Pleurotoma (Drillia) principalis. Tokunaga, Foss. Env. Tokyo, p. 14, pl. I, fig. 23.
Drillia principalis. Pilsbry, Cat. Mar. Moll. Japan, p. 17, pl. II, figs. 9, 10.

Pilsbry in the above cited work describes this species in full. Therefore I add here only that the oblique longitudinal folds in the body-whorl decrease in size near the last part of it, often becoming obsolete.

The specimens are rather numerous, especially at Naganuma. From Koshiba we possess only young ones.

Fossil occurrence.—Koshiba Zone (Koshiba) and Naganuma Zone (Naganuma); Upper Musashino of Musashi and Shimosa.

Living.—Northern, Central and Western Japan.

18. **Pleurotoma (Drillia) pseudo-principalis,** Yokoyama.

Pl. I. Fig. 21.

Shell turrete, pointed; whorls about thirteen, markedly concave above, somewhat convex below, the boundary between being very sharp and distinct; the concave surface is spirally striated and bounded above by a prominent subsutural thread: the convex surface which occupies the greater part of the whorl is ornamented with oblique longitudinal ribs (about twelve on the penultimate whorl) which are generally narrow and sharp in the lower whorls, and broad and rounded in the upper; but in the lower whorls also, there are occasionally such broad ones between. These ribs begin abruptly below the concave surface and continue to the lower suture either in the same strength or gradually weakening. The interspaces between the narrower ribs are much broader than the latter, while those between the broader ones in the upper whorls are either equal to, or narrower than, the ribs; they are everywhere spirally threaded, with threads equal and generally indistinct or obsolete on the ribs. On the body-whorl, the ribs are somewhat flexuous, weaker and closer together toward its last part and vanishing on the base. Aperture elongated, with a deep sinus below the infrasutural thread with the outer lip below it broadly arched forward. Canal short, nearly straight. Height 28 millim. Diameter 8 millim. Length of aperture obliquely measured 9 millim. Rather rare.

This shell looks not unlike the preceding species, but the body-whorl is comparatively longer, the shape more slender and the sub-basal sinus is absent.

Fossil occurrence.—Yokosuka Zone (Otsu): Naganuma Zone (Naganuma).

19. Pleurotoma (Drillia) quantoana, Yokoyama.

Pl. I. Fig. 22.

Shell turrete; spire moderately high, consisting of many whorls; whorls somewhat angulated a little below the middle, the angle being formed by a spiral riblet; the surface above the angle is flat, sloping, ornamented with five to six spiral threads, the second one of which from above is stronger than the others and almost equal to the riblet of the angle; the surface below the angle is perpendicular with two riblets of about the same size as the one above them, except on the body-whorl in which there are subequal riblets which generally gradually decrease in size toward below. Periphery rounded. Canal short, straight. Sinus moderately deep, a little distant from suture, with the lip below arched forward.

Unfortunately a single specimen obtained lacks both apex and outer lip. The preserved whorls are only five, but they seem to have been about ten in number which would make the height about 25 millim. Diameter 7 millim.

In general form this species reminds us of *Pleurotoma vertebrata* Smith (Proc. Zool. Soc., 1879, p. 186, pl. XIX, fig. 6) from Central Japan which is, however, tricarinate.

Fossil occurrence.—Naganuma Zone (Naganuma); Upper Musashino of Musashi.

20. Pleurotoma (Drillia) cosibensis, Yokoyama.

Pl. I. Fig. 26.

Shell small, fusiform; whorls eight, the two first smooth and rounded, the others shouldered, with the surface above shoulders concave and below them convex; the concave surface has an impressed spiral line in its bottom; the convex surface is ornamented with many oblique, obtuse, longitudinal riblets, nineteen in the penultimate whorl, gradually diminishing in size toward the lower suture and separated by interspaces of a less breadth; the interspaces as well as the ribs are provided with fine

subequal spiral threads. In the body-whorl the ribs disappear below the rounded periphery, with only spiral threads on the base. Aperture sub-rhombic, angular behind, passing in front into a short wide canal slightly bent backward. Columella smooth. Outer lip thickened but sharp-margined. Sinus moderately deep, somewhat below suture, with the margin below it broadly arched forward. Sub-basal notch wide and shallow. Height 17 millim. Diameter 5,5 millim. Length of aperture and canal together 6,5 millim. Rather frequent.

This species is also allied to *Pleurotoma principalis* above mentioned, but is smaller and the ribs much more numerous.

Fossil occurrence.—Koshiba Zone (Koshiba).

21. **Pleurotoma (Drillia) nivalioides**, Yokoyama.

Pl. I. Fig. 27.

Shell small, turrete, with body-whorl nearly one-half the shell-height; whorls eleven, shouldered with the exception of two embryonal ones which are convex; shoulders furnished with obliquely elongated tubercles separated by somewhat wider interspaces; surface above shoulders flatly concave, transversely striated, with a subsutural thread in the upper part; surface below shoulders nearly perpendicular with two vertical threads proceding from each tubercle and crossed by a few unequal transverse threads with cross-points more or less tubercular. On the body-whorl, the infra-tubercular vertical threads are crossed by many unequal, rather distant, transverse ones, so that the whole surface appears cancellated, with cross-points more or less tubercular as in the upper whorls. Inner lip smooth, with a thin callus, somewhat flexuous. Canal short, recurved. Sinus rather shallow.

There are two specimens, one from Koshiba and one from Naganuma. Both lack the outer lip; but that it was broadly arched forward below the sinus is quite certain. The Koshiba specimen measures 16 millim. in height, 4,5 millim. in diameter, and 6 millim. in length of aperture, and shows twenty tubercles on the penultimate whorl, while that of Naganuma is 14 millim.

in height, 4 millim. in diameter, 3,8 millim. in length of aperture and has fifteen tubercles on the penultimate whorl. In general the former seems to have been much water-worn.

This species has a great resemblance in shape to *Bela nivalis* Loven of the North Atlantic (Tryon, Man. Conch., VI, pl. 7, fig. 82) in which the whorls are more convex, the canal longer and the shoulders not tuberculated.

Fossil occurrence.—Koshiba Zone (Koshiba); Naganuma Zone (Naganuma); Upper Musashino of Oji.

22. **Pleurotoma (Drillia) benten,** Yokoyama.

Pl. I. Fig. 23.

Shell small, polished, rather fusiform, the greatest diameter being somewhat below the middle; whorls eight, of which the two first are smooth and rounded, and the others with the upper one-third smooth and flat or flatly concave, and the lower two-thirds convex and obliquely plicated; plicæ broad and blunt, with interspaces of nearly equal breadth, about nine in the penultimate whorl, and almost obsolete in the last part of the body-whorl. Spiral sculpture entirely absent. Periphery rounded. Aperture somewhat widened above, passing below into a wide, short and nearly straight canal which is truncate at base. Inner lip smooth. Outer lip sharp, with a very deep and interiorly somewhat widened sinus at some distance from the suture. Lip-margin below the sinus arched forward and with a shallow sub-basal notch. Height 12 millim. Diameter 3,5 millim. Length of aperture 4 millim.

A single, but perfect specimen.

Fossil occurrence.—Naganuma Zone (Naganuma).

23. **Pleurotoma (Drillia) braunsi,** Yokoyama.

Pl. I. Fig. 25.

Shell small, fusiform, body-whorl somewhat longer than half the shell-height; whorls about eight, the upper two smooth and rounded, the others longitudinally and somewhat obliquely ribbed;

ribs about ten in the penultimate whorl, rounded, separated by interspaces of about equal breadth, and present only in the lower two-thirds of the whorls, the surface above being smooth and somewhat concave. No spiral sculpture. Periphery formed by the shoulders of ribs, below which the surface is convex, with ribs gradually weakening and vanishing in the base. Aperture subrhombic, passing into an elongated and slightly recurved canal in front. Inner lip smooth; outer lip sharp, strengthened externally by a rib. Sinus distinct, but shallow and broad, and situated somewhat below the suture. Height 14 millim. Diameter 5 millim. Length of aperture together with canal 6 millim. Not rare at Koshiba.

Fossil occurrence.—Koshiba Zone (Koshiba) and Naganuma Zone (Naganuma)

24. **Pleurotoma (Mangilia) deshayesii,** Dunker.

Pl. I. Fig. 24.

Mangilia deshayesii. Dunker, Moll. Jap., p. 3, pl. I, fig. 3. Pilsbry, Cat. Mar. Moll. Japan, p. 19. Tryon, Man. Conch., VI, p. 256, pl. 22, fig. 71.

A single specimen.

The shell is small, rather thin, and fusiform. The whorls number seven, the two first being embryonal and smooth; the remaining ones have the upper third sloping and flat, and the lower two-thirds perpendicular and flatly convex. The sculpture consists of longitudinal riblets and spiral threads. The riblets are straight, obtuse, reaching from the upper suture to the lower, about twelve in number in the body-whorl and separated by interspaces of a nearly equal breadth. The threads are four in number in whorls excepting the last one, unequal, the uppermost being the smallest and the second the largest, the two lower ones being nearly equal in size. The threads in the body-whorl are unequal and many, covering also the whole base where there are also longitudinal riblets. Inner lip smooth. Canal elongated, nearly straight. The outer lip is broken, but the sinus seems to have been close to the suture and rather shallow. Height 9 millim. Diameter 2,5 millim. Length of aperture 4,5 millim.

This shell is, I believe, what Dunker described under the above name, though his description is brief and the figures are rather indistinct.

Fossil occurrence.—Koshiba Zone (Koshiba); Upper Musashino of Shimosa.

Living.—Western Japan.

25. **Pleurotoma (Mangilia) miyatensis,** Yokoyama.

Pl. V. Fig. 2.

Shell small, rather thick, fusiform. Whorls about seven, the first two being smooth and rounded, and the remaining ones with the upper one-third sloping and slightly concave and the lower two-thirds perpendicular and nearly flat. The sculpture consists of longitudinal costellæ and spiral threads whose crossing points are more or less tuberculated. The costellæ are numerous, close, rounded or even flattened, about twenty-one in the penultimate whorl, separated by interspaces of a less breadth, somewhat bent backward at the angles with the part above them strongly oblique, below them only a little so. The threads are finer on the sloping surface, coarser on the perpendicular, usually five in each, sometimes with one or two interstitial ones. On the body-whorl, the costellæ become obsolete towards the aperture and base which latter is usually provided only with spiral threads. Aperture elongated. Inner lip smooth. Outer lip rather thin, with a broad shallow notch, a little below the suture, situated where the surface makes an angle.

There are several examples, of which the largest shows the following dimensions:

Height 20 millim. Diameter 7 millim. Length of body-whorl 12 millim. Length of aperture 9,5 millim.

Fossil occurrence.—Miyata Zone (Shimo-Miyata and Kami-Miyata).

26. **Pleurotoma (Surcula ?) nojimensis,** Yokoyama.

Pl. I. Fig. 19.

A single specimen lacking apex and outer lip.

The shell is fusiform and rather solid. The whorls may have been about nine in number, but those which are preserved are only five. They are sharply keeled, with the keel much nearer to the lower suture than to the upper; the surface above the keel is sloping and very slightly convex, below it somewhat receding and nearly perpendicular. The sculpture consists of spiral impressed lines which make the interspaces look like threads which are generally subequal and flatly convex, especially above the keel. The number of these threads varies, but commonly a little over ten above the keel and three below it, except on the body-whorl in which there are many infra-carinal threads down to the very end of the canal. Inner lip smooth. Sinus somewhat below the suture and just above the keel, shallow and broad. Canal moderate, recurved. Height about 17 (?) millim. Diameter 6,5 millim.

This species shows a great resemblance to *Surcula clara* Mart. (Tryon, Man. Conch., VI, pl. 6, fig. 77) of Patagonia in the form of the whorls, but the canal in the latter is much longer and straighter.

Fossil occurrence.—Kanazawa Zone (Nojima).

27. Pleurotoma (Bela ?) glabra, Yokoyama.

Pl. II. Fig. 1.

A single specimen. It is small, thin-shelled, short-fusiform, with about six convex, perfectly smooth whorls. The body-whorl is longer than the spire. The inner lip is smooth without any callus. The outer lip is thin and broken. The canal is recurved and broken at the anterior end, but it seems not to have been long. The sinus as judged by growth-lines is near the suture, shallow with the lip-margin below it broadly arched. The diameter is 4 millim. The height, if perfect, would be about 10 millim.

Fossil occurrence.—Koshiba Zone (Koshiba).

Family Cancellariidæ.

Genus *Cancellaria*, Lamarck.

28. Cancellaria spengleriana, Deshayes.

Pl. II. Figs. 2, 3.

Cancellaria spengleriana. Sowerby, Thes. Conch., vol. II, p. 438, pl. 93, fig. 29. Dunker, Index Moll. Mar. Jap., p. 103. Tokunaga, Foss. Env. Tokyo, p. 11, pl. I, fig. 15.

This is a shell which is very frequently met with living in Central and Western Japan. The form is in general suboval with a short but pointed spire. The whorls number about eight, of which the first two are embryonal and smooth; the others are angulated, with the surface above the angle somewhat sloping or nearly horizontal, and with the surface below the same nearly perpendicular, so that the angle may be obtuse or sometimes nearly right-angled. The sculpture consists of rounded longitudinal ribs and fine spiral grooves which latter make the surface between them look like broad flattened transverse riblets. The number of longitudinal ribs varies between ten and fifteen, so that in some specimens they are closer than in others. They are more or less tuberculated at the angle, the tubercles often being sharp and somewhat spiny. Below the angle and especially in the body-whorl, their crossing points with the spiral riblets show a tendency to elevate themselves into tubercles. The oblique folds of the columella are normally three in number, but there is often a fourth one developed between the upper two, though somewhat smaller. The lip outside of the folds is more or less tubercular, with rounded and elongated elevations, Sowerby's description, that the columella is granulated probably pointing to this character. The outer lip is denticulate at margin with many distant spiral threads within. Rather frequent.

Fossil occurrence.—Yokosuka Zone (Otsu); Naganuma Zone (Naganuma); Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Central and Western Japan; Philippines; Australia.

Genus ***Admete***. Kroyer.

29. **Admete viridula** (Fabricius).

Pl. II. Fig. 5.

Admete viridula. Sars, Moll. Norv. Arct., p. 402. Middendorf, Moll. Ross., II. pl. 10, figs. 3–4. Kobelt, in Syst. Conch. Cab. von Martini und Chemnitz, vol. IV, part 4, Genus Cancellaria, p. 98, pl. 24, figs. 1–7. Dunker, Index Moll. Mar. Jap., p. 104. Tryon, Man. Conch., vol VII. p. 84, pl. VII, figs. 23–28.

Admete crispa. Möller, Ind. Moll. Groenl., p. 15.

Tritonuins viridulum. Fabricius, Fauna Groenl., p. 402.

Cancellaria viridula Sowerby, Thes. Concl. II, p. 449, pl. 96, fig. 102.

The shell is thin, ovately conical and subturrete: the whorls are about six in number of which the upper two are smooth and rounded: the other whorls are convex, obtusely and faintly angulated somewhat above the middle, with the surface above it sloping, and below it a little convex. Spirally striated; striæ distinct, but inequidistant, unequal, the largest one being just at the place of angulation above which in the penultimate whorl there is a single fine stria, while there are four subequal ones below. In the body-whorl which is quite swollen, the angle is rather indistinct, with thirteen striæ below it, which are at first rather distant, but get closer and finer toward the base. Lines of growth unequal and coarse, so coarse in some places as to look like longitudinal riblets: and indeed in the upper whorls they are really changed into such. Aperture ovate: outer lip sharp with margin smooth: columella arcuate with a thin callus spread over it and with three indistant oblique folds, the middle one of which is the weakest. Canal indistinct. Only a single specimen. Height 8.5 millim. Diameter 5 millim. Length of aperture 4 millim.

This species is said to be very variable in shape. Tryon in his Manual of Conchology considers *Cancellaria subangulosa* Wood of the Crag, *Admete buccinoides* Couth. of the east coast of America and *Admete costellifera* Sow. (habitat?) as identical with the present species. Anyhow the variability is certain, and our only specimen looks most like the one shown in fig. 4, pl. 24 of Kobelt.

Fossil occurrence in Japan.—Koshiba Zone (Koshiba).

Fossil occurrence in foreign countries.—Pliocene of Belgium; Pliocene of England (Tryon).

Living.—Circumboreal; in Japan, in Aniwa Bay, Sakhalin.

Family **Volutidæ.**

Genus ***Voluta***, Linné.

30. Voluta megaspira Sowerby.

Pl. II. Fig. 18.

Voluta megaspira. Sowerby, Thesaur. Conch., vol. I, Voluta, p. 208, pl. 48, figs. 31, 32. Dunker, Index Moll., p. 49. Lischke, Jap. Meeres Conch., II, p. 167, III, p. 43. Pilsbry, Cat. Mar. Moll. Jap., p. 24.

Voluta lyriformis. Küster in Conch. Cab. Martini u. Chemn., vol. V, pl. 2, Volutacea, p. 177, pl. 28, fig. 1.

Numerous specimens, especially from Koshiba, agree very well with our living forms and also with the one figured by Küster from an unknown locality. The longitudinal ribs or plications generally become obsolete in the body-whorl, at least in its last part. Traces of transverse striations are visible in some specimens, especially in the upper half of the whorls. The columella folds vary in number, but at least two with the lower stronger, but often an intermediate fold and also a weaker one above the upper fold are developed.

The largest specimen from Koshiba which lacks the lower portion is 40 millim. in diameter, so that the height, if perfect, would be about 120 millim. The number of whorls is seven and a half.

Fossil occurrence.—Miyata Zone (Iwaiguchi and Jinya-ato in Kami-Miyata); Kamakura Zone (Kewaizaka in Kamakura); Kanazawa Zone (Nojima and Kanazawa); Koshiba Zone (Koshiba); Naganuma Zone (Naganuma and Iijima). Upper Musashino of Kazusa.

Living.—Northern, Central and Western Japan.

Family Mitridæ.

Genus *Mitra*, Lamarck.

31. Mitra ebenus, Lamarck.

Pl. II. Fig. 4.

Mitra ebenus. Lamarck, Annal. du Mus., vol. XVII, No. 58. Hist, Nat. VII, p. 319, No. 58. Sowerby, Thesaur. Conch., IV, Mitra p. 32, No. 428, pl. 368, figs. 329, 334–336. Tryon, Man. Conch., IV, p. 124, pl. 36, figs. 84–88, pl. 37, figs. 89, 90. Philippi, Enum. Moll. Sicil., vol. I, p. 229, pl. XII, figs. 9, 10. Wood, Crag Moll., supplem., p. 7, pl. III, fig. 6. Hörnes, Foss. Moll. Wiener Beckens, I, p. 109, pl. X, figs. 11–13.

Mitra pyramidella. Cerulli-Irelli, Fauna Mal. Mar., pt. V, p. 237, pl. XXI, fig. 23.

This polymorphous shell is represented by a single specimen 7 millim. in height and 3 millim. in diameter. It is fusiform in shape, with about six whorls which are a little convex, and in general smooth, though faint indications of longitudinal folds are visible in some places. The sutures are deep, making the whorls look somewhat telescopic. Columella folds four, with the uppermost the strongest; the others are somewhat distant from the uppermost with the lowest very weak and hardly visible. Aperture subrhombic, elongated. Canal short and recurved. The general feature of the shell is like the Crag form, though not so slender, in which respect our specimen looks more like fig. 336 of Sowerby. The Crag species is said to have only a single columella fold and is accordingly treated as var. *uniplicata* by Wood.

Fossil occurrence in Japan.—Koshiba Zone (Koshiba).

Fossil occurrence in foreign countries.—Coralline Crag of England, Pliocene of Italy, Miocene of France, Germany, Austria etc.

Living.—Mediterranean Sea and Atlantic coast of Northern Africa.

32. Mitra fusiformis, (Brocchi).

Pl. II. Fig. 6.

Mitra fusiformis. Wood, Crag Moll., supplem., p. 8, pl. V, fig. 3 ab. Hörnes, Foss. Moll. Wiener Beckens, vol. I, p. 98, pl. X, figs. 4–7. Cerulli-Irelli, Fauna Malac. Mariana, pt. V, p. 235, pl. XXI, fig. 19.

Voluta fusiformis. Brocchi, Conch. Foss. Subap., vol. II, p. 315, No. 16.

A single specimen lacking the apex. In a perfect state, it would have measured about 24 millim. in height. The whorls are

smooth, plano-convex, separated by deep, impressed sutures. The columella folds number four, the lowest being the smallest and somewhat indistinct. In the lower part of the body-whorl, transverse striations are faintly visible which seem to have been mostly obliterated by friction. Our specimen shows the greatest resemblance to the figures given by Hörnes, with a slight difference in the outer lip which curves more rapidly inward below than in the Vienna form, thus making the breadth of the lower end of the canal somewhat narrower.

Fossil occurrence in Japan.—Koshiba Zone (Koshiba).

Fossil occurrence in foreign countries.—Red Crag of England, Subappenine formation of Italy, Miocene of Vienna, Bordeaux, Dax. etc.

33. **Mitra plicifera,** Yokoyama.

Pl. II. Fig. 16.

Shell elongate-fusiform, rather thin, with spire pointed; whorls about ten, moderately convex, longitudinally ribbed and also spirally finely grooved; ribs many, fourteen to sixteen in number, elevated, flatly roof-like with broadly V-shaped interspaces in the upper whorls, less elevated and rounded in the lower, becoming almost obsolete in the body-whorl; spiral grooves small, more than ten in number, except in the body-whorl where they increase to more than thirty, subequal or unequal, and generally with flat-bottoms. Aperture elongated, Columella folds three, oblique with the middle one weaker than the other two.

There are several specimens which, however, have the outer lip and canal broken. But the canal seems to have been moderately long. The shell is tolerably large, the largest specimen measuring about 20 millim. in diameter. The entire height may have been about four times as much.

This species is in shape not unlike *Mitra scrobiculata* Broc. (Conch. Foss. Subap., II, p. 317. No. 17) from the Pliocene of Italy and also from the Vienna Basin. But it is easily distinguished from the latter by the presence of longitudinal ribs in the upper whorls.

Fossil occurrence.—Koshiba Zone (Koshiba).

34 **Mitra (Costellaria) emmæ**, Yokoyama.

Pl. VI. Fig. 4.

A single example, 12 millim. in height and 4.5 millim. in diameter.

The shell is small, rather solid and fusiform in shape, with the body-whorl nearly twice as long as the spire. The whorls are eight in number and, with the exception of the first two smooth rounded ones, flattened in the upper half and convex in the lower. They are longitudinally plicate; the plicæ which number about twenty-two on the penultimate whorl, are low, roof-like and somewhat oblique, being separated by broad v-shaped valleys which show fine, indistinct, spiral lines. The base is to a greater part smooth, the only ornaments being the weak continuations of the longitudinal plicæ and a few spiral ribs found at its extreme end which are runners of the oblique folds of the inner lip. The latter number four in all, decreasing in size from above downward. Outer lip broken.

This species is much like a shell figured by Smith as a variety of *Mitra inermis* Reeve in the Proc. Zool. Soc. London, 1879 (pl. XX, figs. 53, 53 a). But in the latter the lower half of the whorls is not convex as in ours.

Fossil occurrence.—Miyata Zone (Shimo-Miyata).

Family **Fasciolariidæ.**

Genus ***Fusus***, Lamarck.

35. **Fusus niponicus**, Smith.

Pl. II. Fig. 7.

Fusus niponicus. Sowerby, Thes. Conch., vol. IV, p. 79, pl. 411, fig. 70. Smith, Proc. Zool. Soc. London, 1879, p. 203, pl. XX, fig. 12.

Two young specimens, one of which is imperfect but larger, measuring 28 millim. in height, while the other more perfect one measures 23 millin. in height. The whorls are about eight in number, of which the uppermost two are embryonal, smooth and

shining; the others are moderately convex and longitudinally plicated, with plicæ about fifteen in number on the penultimate and obsolete on the body-whorl. There are also distant spiral threads, about six on the penultimate and many on the ultimate whorl, which on crossing the plicæ elevate into compressed transversely elongated tubercles. The interspaces between threads are filled up by finer spiral threads or striæ. Aperture rhombic, passing below into a long canal somewhat curved backward. Outer lip is thin and broken in our specimen, but it is said to be crenate within according to SOWERBY.

Fossil occurrence.—Miyata Zone (Maruyama-no-Saka in Shimo-Miyata); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living.—Central Japan.

36. **Fusus perplexus**, A. ADAMS.

Pl. II. Fig. 17.

Fusus perplexus. A. ADAMS, Jour. Linn. Soc., 1864, VII, p. 106. PILSBRY, Cat. Mar. Moll. Japan, p. 26. TOKUNAGA, Foss. Env. Tokyo, p. 6, pl. I, fig. 6.

Fusus inconstans. LISCHKE, Jap. Meeres Conch., 1, p. 34, pl. II, figs. 1–6, II, p. 26, pl. III, figs. 1–5. BRAUNS, Geol. Env. Tokio, p. 55.

Three imperfect specimens which, however, can easily be recognized by the longitudinal plicæ and unequal spiral threads. The living representative of this species is very common on the coast of Central Japan.

Fossil occurrence.—Naganuma Zone (Naganuma); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern, Central and Western Japan.

Family **Buccinidæ**.

Genus ***Chrysodomus***, SWAINSON.

37. **Chrysodomus phœniceus**, DALL.

Pl. II. Figs. 8, 9, 10.

Chrysodomus phœniceus. DALL, Proc. U. S. Nat. Mus., vol. XIV, 1891, p. 187, vol. XVII, 1895, p. 708, pl. XXIX, fig. 1.

The shell is ovately fusiform and rather solid; the whorls number about six with the uppermost two embryonal and smooth;

the other four are convex and spirally threaded, with threads unequal, several smaller (unequal) threads being found between the larger and more distant ones.

Growth-lines coarse. Aperture subrhombic, with a short recurved canal.

The whorls show some variation in form. When the larger spiral threads are very coarse, the whorls, especially the body-whorl, are sub-angulated at the periphery (fig. 10.); when they are not specially coarse, then the whorls are more rounded (fig. 9). Fig. 8 shows a form intermediate between the two.

Rather frequent.

Fossil occurrence.—Kanazawa Zone (Nojima); Koshiba Zone (Koshiba); Naganuma Zone (Iijima and Kikkōsan).

Living.—British Columbia (50° 49′ N. Lat.), at 238 fathoms with water-temperature 7°C. A specimen is in my possession from an unknown locality in Japan, measuring 53 millim. in height.

38. **Chrysodomus schrencki,** Yokoyama.

Pl. III. Fig. 1.

The specimens are frequent, but invariably more or less fractured, so that a full description of the shell must be postponed to the future.

In general, however, the shell is moderate-sized, rather thin and turrete-fusiform in shape. The whorls which may number about ten are convex and separated from each other by a narrow, but distinct, shallow, horizontal canal, bordered exteriorly by a low ridge. Body-whorl long, about as long as the spire. The sculpture consists of regular, subequidistant, spiral, impressed lines which number about twelve on the penultimate whorl. Aperture oval, passing below into a short, rather bent canal. Growth-lines coarse. The figured specimen measures about 35 millim. in diameter. Its height, if perfect, would be about 100 millim.

This species is closely akin to *Chrysodomus pericochlion* Schrenck (Moll. nord. japan. Meeres, p. 433, pl. XVII, figs. 11, 12) of Northern Japan. But the latter has flatter whorls, narrower

sutural canals, and dense, rather insignificant spiral striæ instead of regular, distant, impressed lines.

Fossil occurrence.—Kanazawa Zone (Nojima); Koshiba Zone (Koshiba); Naganuma Zone (Naganuma).

Genus ***Sipho***, Klein.

39. **Sipho obesiformis**, Yokoyama.

Pl. II. Fig. 13.

Shell small, rather thin, ovately fusiform; whorls seven, the uppermost smooth and mammillary, the others somewhat convex, spirally striated and longitudinally plicated; striæ subequal, flat-topped, with or without a finer interstitial line, about ten in number on the penultimate, more than thirty on the last whorl; longitudinal plicæ most distinct on the upper whorls, thirteen on the fourth whorl, almost or wholly obsolete on the last two. Aperture ovate with a posterior corner acute. Canal short, much recurved. Inner lip smooth. Outer lip thin, sharp, smooth within and describing a broad arc.

Two specimens. One is 16 millim. in height and 7 millim. in diameter; the other 12 millim. in height and 6 millim. in diameter.

In shape, this shell is like *Sipho obesus* Sow. (Tryon, Man. Conch., III, p. 132, pl. 87, fig. 624, Sowerby Thes. Conch., IV. Fusus, fig. 92) which is, however, much larger and devoid of longitudinal plicæ.

Fossil occurrence.—Naganuma Zone (Naganuma).

Genus ***Siphonalia***, Swainson.

40. **Siphonalia dilatata**, (Quoy).

Pl. II. Fig. 12.

Siphonalia dilatata. Tryon, Man. Conch., III, p. 135, pl. 54, figs. 356-359.
Fusus dilatatus. Quoy, Voy. de l'Astrolabe, pl. I, pl. 34, figs. 15-16.

A fine specimen, 45 millim. in height. It has only about five whorls and a half of which the first one and the next half are mammillary and smooth. The shoulders are sharp and distinct as in

the figures given by Tryon. The number of peripheral tubercles is eleven on the body-whorl. The shell is thick and solid.

Fossil occurrence.—Miyata Zone (Shimo-Miyata).

Living.—Japan (A. Adams): New Zealand.

41. Siphonalia spadicea, (Reeve).

Pl. III. Figs. 8, 9, 10, 11.

Siphonalia spadicea. A. Adams, Ann. Mag. Nat. Hist., 1863, vol. XI, p. 203. Smith, Proc. Zool. Soc., 1879, p. 205, pl. 20, fig. 38. Dunker, Index Moll. Maris Jap., p. 16.

Buccinum spadiceum. Reeve, Conch. Icon., Buccinum, Index.

Buccinum fusoides. Reeve, Conch. Icon., sp. 64. (not sp. 9).

Shell fusiform, generally rather thin; spire acute; whorls seven to nine, obtusely angulated or rounded; longitudinally plicate; plicæ strong and present on all the whorls, or weak and wholly or nearly obsolete on the lower whorls, strongest at the angle and about twelve on the body-whorl; spirally striated; striæ many, equal or unequal, close or distant with one or two interstitial lines in the latter case. The base is devoid of longitudinal plicæ even in the strongly plicated forms. Aperture ovate, posteriorly angulated, passing in front into a short strongly recurved canal. Inner lip smooth, generally with only a thin callus. Outer lip, thin, sharp, smooth or only with faint lines within, corresponding to the outer spiral striæ. The largest specimen which has only the spire preserved seems to have been more than 60 millim. in height.

This is a very variable species. Reeve founded his species on a strongly plicate specimen. But as may be clearly seen from our figures, the plicate form passes gradually into the one without plicæ on the lower whorls. The outer lip is thin in all our specimens, except one, in which it is somewhat thickened, though sharp-edged; its interior, however, is invariably smooth. Very frequent at Shimo-Miyata.

Fossil occurrence.—Miyata Zone (Shimo-Miyata and Motowada); Yokosuka Zone (Otsu); Naganuma Zone (Naganuma). Upper Musashino of Kazusa.

Living.—Central Japan.

42. Siphonalia trochulus, (Reeve).

Pl. II. Fig. 14.

Siphonalia trochulus. Dunker, Index Moll. Mar. Jap., p. 16. Tryon, Man. Conch., III, p. 136, pl. 55, fig. 373. Pilsbry, Cat. Mar. Moll. Jap., p. 30.

Buccinum trochulus. Reeve, Conch. Icon., sp. 7.

Neptunea (Siphonalia) trochulus. Mart. u. Chem., Syst. Conch. Cab., III, pl. 3, p. 128, pl. 42, figs. 2, 3.

Our single specimen which is 38 millim. in height and 22 millim. in diameter is characterized by a short spire, a large and ventricose body-whorl and spiral threads without any longitudinal sculpture. The outer lip is thin and smooth within. But among the specimens of the living shell, there are those with transverse ribs within, in which case the lip is invariably more or less thick, and the upper whorls more or less longitudinally plicate, so that in these respects, the shell seems to be tolerably variable.

Fossil occurrence.—Naganuma Zone (Naganuma). Upper Musashino of Shimosa and Kazusa.

Living.—Central Japan.

43. Siphonalia fuscolineata, Pease.

Pl. II. Fig. 15.

Siphonalia fuscolineata. Pease, Proc. Zool. Soc. London, 1860, p. 189, pl. 51, fig. 3. Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, 1891, p. 473, pl. XIX, fig. 4.

This is a species very closely allied to some forms of *Siphonalia spadicea* from which it could not be distinguished, if it were not for the inner side of the thickened outer lip, which is transversely and closely ribbed. Should this character not be enough for specific distinction, then the two species must be united into one.

A single specimen with eight whorls, 33 millim. in height and 20 millim. in diameter.

Fossil occurrence.—Naganuma Zone (Naganuma).

Living.—Inland Sea (Western Japan) and Minoshima (in Nagato) according to Adams.

44. Siphonalia stearnsii, Pilsbry.

Pl. III. Figs. 3, 4.

Siphonalia Stearnsii. Pilsbry, Cat. Mar. Moll. Japan, p. 29, pl. II, figs. 1, 2.

Several specimens which agree pretty well with the figures and descriptions given by Pilsbry. Compared with *Siphonalia*

fuscolineata, the shell is more ventricose and the spire shorter. Compared with *Siphonalia spadicea*, to some forms of which it shows a great resemblance, it differs by having the outer lip thickened and transversely ribbed within. *Siphonalia trochulus* is more ventricose with all the whorls generally longitudinally plicate.

One of the specimens at hand is somewhat more swollen than others, and the plicæ are very obscure also on the upper whorls (fig. 4).

Fossil occurrence.—Naganuma Zone (Naganuma).

Living.—Japan (Pilsbry).

Genus ***Buccinum***, Linne.

45. **Buccinum leucostoma**, Lischke.

Pl. II. Fig. 11.

Buccinum leucostoma. Lischke, Jap. Meeresconch., vol. III, p. 38, pl. 1, figs. 7, 8. Pilsbry, Cat. Mar. Moll. Japan, p. 32.

Two badly preserved, imperfect specimens which, however, are readily recognizable as Lischke's species by their ovately conical shape with very convex rounded whorls ornamented by numerous, unequal spiral threads. The larger specimen measures 18 millim. in diameter, with both apex and canal broken. It may have been about 38 millim. in height.

Fossil occurrence.—Kanazawa Zone (Nojima).

Living.—Central Japan.

Genus ***Volutharpa***, Fischer.

46. **Volutharpa perryi**, Jay.

Pl. III. Fig. 12.

Volutharpa perryi. Dunker, Index Moll. Mar. Japon., p. 33. Pilsbry, Cat. Mar. Moll. Japan, p. 32. Tryon, Man. Conch., III, p. 200, pl. 79, fig. 38. Tokunaga, Foss. Env. Tokyo, p. 8, pl. 1, fig. 11.

Bullia perryi. Jay, Report on Shells coll. by Japan, Exped. under Command of Comm. Perry. 1856, p. 295, pl. V, figs. 13–15.

? Tritonium (Volutharpa) ampullaceum. Schrenck, Moll. Amurl. u. d. nordjap. Meeres, p. 347.

Two small specimens, one of which is a mere fragment. This is a very characteristic species with a thin shell, a short spire, a

strongly swollen body-whorl and a large wide aperture. The surface which is apparently smooth, when examined with a lens, reveals very fine spiral striæ decussated by lines of growth.

Schrenck considers *Volutharpa ampullacea* (Mid.) as identical with this species. But Middendorff's species is said to be deep purple in colour, while Jay's is light-coloured (yellowish-ash). I leave the question open.

Fossil occurrence.—Miyata Zone (Shimo-Miyata); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Central Japan (Tokyo Bay); Northern Japan (Hakodate).

Family Nassidæ.

Genus *Nassa*, Martini.

47. Nassa (Hima) japonica, A. Adams.

Pl. III. Fig. 5.

Nassa japonica. A. Adams, Proc. Zool. Soc. London, 1851, p. 110. Lischke, Jap. Meeresconch., III, p. 37, pl. II, figs. 20–23. Brauns, Geol. Env. Tokio, p. 29. Tokunaga, Foss. Env. Tokyo, p. 9. Non *Nassa japonica* Lischke in Jap. Meeresconch., I, p. 61 (=*Nassa balteata* Lischke). Non *Nassa japonica* Reeve, Conch. Icon., Nassa, pl. 29, fig. 192 (= *Desmoulea japonica* A. Adams).

Caesia japonica. H. and A. Adams, Ann. Mag. Nat. Hist., 1870, vol. 5, p. 426.

Nassa tenuis. Smith, Ann. Mag. Nat. Hist., 1875, p. 423; Proc. Zool. Soc. London, 1879, p. 211.

Lischke says of this species:

"Turrete, thin-shelled, with nine whorls, of which about two belong to the embryo; the others are strongly rounded and separated from one another by deep sutures. The largest of our specimens is 15 millim. long (of which 5 millim. fall on the aperture) and 7,5 millim. broad. The sculpture consists of longitudinal ribs and spiral threads; the former become generally indistinct on the last whorl, but distinct again near the aperture, while the latter are more sharply bounded, their number being four on the first whorls, five on the penultimate and ten to eleven on the ultimate. These threads run over the longitudinal ribs forming more or less distinct tubercles at their points of intersection. The interspaces are nearly as long and broad as the threads and

longitudinally striated. The aperture is ovate; the columella is covered with a thin, narrow and shining inner lip which has above a fold-like tubercle, below, where the outer margin of the lip is free, some weak wrinkles. This inner lip is somewhat curved inward, while at its base it becomes suddenly straight and is then obliquely truncate. The outer lip is thin, and sharp, crenate on account of the external spiral threads and especially in the anterior portion; somewhat distant from the outer margin, the inner surface of the outer lip is toothed, the teeth arising from the short foldings of the inner wall."

A few specimens, not quite full grown, agreeing exactly with the above description, have been collected only at one locality. The largest of them measures only 10,5 millim. in height and 5 millim. in diameter. The whorls number eight.

Fossil occurrence.—Yokosuka Zone (Yokosuka); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Central and Western Japan.

48. **Nassa (Hima) festiva**, Powis.

Pl. III. Fig. 6.

Nassa festiva. Powis, Proc. Zool. Soc. London, 1835, p. 95. Lischke, Jap. Meeresconch., vol. II, p. 53. Dunker, Index Moll., p. 37. Tryon, Man. Conch., IV, p. 46, pl. 14, figs. 239-242.
Nassa lirata. Dunker, Moll. Jap., p. 7, pl. I, fig. 22.

A few young specimens. The shell is ovately conical; the whorls number seven, of which two belong to the embryo; the others are convex, longitudinally plicated and spirally striated; the plicæ are coarse, rounded, broad, separated by interspaces of less breadth, ten on the penultimate whorl; the spiral striæ are equal, flat-topped, distant, narrower than the interspaces, four on the upper whorls, four or five on the penultimate and about ten on the last whorl. The aperture is ovately round. Inner lip with a callus whose outer edge is free, at least in the anterior portion; a small tooth or fold found near the posterior angle and a few small plicæ in the anterior part. Outer lip thickened by an external varix with a few coarse teeth within. Canal very short and recurved. Height 8 millim. Diameter about 4 millim.

According to Tryon (Man. Conch., IV, p. 46), *Nassa acutidentata* Smith is a synonym and *Nassa dealbata* A. Adams is only a narrower variety.

Fossil occurrence.—Miyata Zone (Kami-Miyata); Naganuma Zone (Naganuma). Upper Musashino of Kazusa and Shimosa.

Living.—Northern, Central and Western Japan.

49. Nassa (Niotha) livescens, Philippi.

Pl. III. Fig. 18.

Nassa livescens. Philippi, Zeitschrift für Malakozoologie, 1848, p. 135. Dunker, Moll. Jap., p. 7. Lischke, Jap. Meeresconch., II, p. 52, pl. IV, figs. 1–3. Dunker, Index Moll. Mar. Jap., p. 35. Brauns, Geol. Env. Tokio, p. 29. Tokunaga, Foss. Env. Tokyo, p. 9.

Nassa kieneri. Tryon, Man. Conch., IV, p. 53, pl. 16, figs. 301–303.

Rather frequent and also found in several localities. Pilsbry states in his "Catalogue of Marine Mollusks of Japan" (p. 35) that the *Nassa kieneri* Desh. mentioned in Tryon's Manual (l.c.) is probably identical with Philippi's species above mentioned and indeed quite rightly, for the two species are connected by many intermediate forms. The typical specimens of *Nassa livescens* show a lower spire than those of *Nassa kieneri*, which character is, however, not at all constant. But there is one constant character invariably found in both species, and that is the callus of the inner lip, which may be thick or thin and has the outer edge always free, at least in its anterior portion.

Nassa marginulata Lam. (Pilsbry's Catalogue p. 35) is said to be a synonym of *Nassa kieneri* Desh. (Tryon Man. IV. p. 54) which is again a synonym of *Nassa livescens* Phil. And this is probably the case also with *Nassa cremata* Hinds (Tryon's Manual, IV, p. 53. pl. 16, figs. 295–300).

The largest of the perfect specimens measures 26,5 millim. in height and 13 millim. in greatest diameter. But there is also a specimen lacking the spire and measuring 15 millim. in its greatest diameter.

Fossil occurrence.—Miyata Zone (Iwaiguchi and Matsubara-Mizufuka-no-fuchi in Kami-Miyata, and Shimo-Miyata); Yokosuka Zone (Yokosuka and Otsu); Naganuma Zone (Naganuma); Upper Musashino of Musashi.

Living.—Central and Western Japan: Philippines; Polynesia; Indian Ocean.

Family **Columbellidæ.**

Genus ***Columbella***, Lamarck.

50. Columbella (Mitrella) dunkeri, Tryon.

Pl. III. Fig. 15.

Columbella (Mitrella) dunkeri. Tryon, Man. Conch., V, p. 129, pl. 49, fig. 15.
Amycla varians. Dunker, Malak. Bl., 1860, p. 231, Moll. Jap., p. 6, pl. 1, fig. 17. Index Moll., p. 55. Smith, Proc. Zool. Soc. London 1879, p. 210, pl. 20, fig. 44. Pilsbry, Cat., p. 40.

This is a smooth, ovately conical shell, sulcate at the base and with the apex acute. The whorls are plano-convex separated by somewhat channelled sutures. The inner lip is smooth, while the outer lip is thickened and coarsely dentate within. Height 15 millim. Diameter 6,5 millim. Length of aperture 6,5 millim. Very frequent.

Fossil occurrence.—Miyata Zone (Kami-Miyata and Shimo-Miyata); Yokosuka Zone (Yokosuka and Otsu). Upper Musashino of Shimosa and Kazusa.

Living.—Northern, Central and Western Japan.

51. Columbella (Atilia) burchardi, (Dunker).

Pl. III. Fig. 7.

Columbella (Atilia) burchardi. Tryon, Man. Conch. V, p. 129, pl. 49, fig. 17.
Amycla burchardi. Dunker, Index Moll., p. 55, pl. IV, figs. 3, 4. Pilsbry, Cat. p. 40.

Two specimens from Yokosuka agree quite well with the figures and descriptions of the above cited species given by Dunker, except in two points, that is, in the spire being somewhat shorter and the upper whorls showing weak longitudinal plications. Three specimens brought from Shimo-Miyata are somewhat more slender and only one of them shows the longitudinal plicæ of the upper whorls. Therefore, these plicæ can only be taken as a subsidiary character. The fine spiral lines which are mostly incised into the shell are often only visible with a lens. The varicose fold of the outer lip is mostly somewhat distant from the edge and sometimes indistinct. Broad form:

Height 16 millim.; diameter 7 millim. Slender form: Height 14 millim.; diameter 5 millim.

Fossil occurrence.—Miyata Zone (Maruyama-no-Saka in Shimo-Miyata); Yokosuka Zone (Yokosuka). Upper Musashino of Kazusa.

Living.—Japan (according to Dunker).

Family **Muricidæ.**

Genus ***Trophon***, Montfort.

52. **Trophon subclavatus**, Yokoyama.

Pl. III. Fig. 2. Pl. VI. Figs. 13, 14.

Several specimens.

Shell angulate-fusiform; spire elevated; whorls about seven, shouldered, with shoulders angular, ornamented with several ridge-like varices numbering eight to ten on the body-whorl and elevating into short spines at the shoulders. Canal long, slightly bent. The largest specimen measures 34 millim. in height and 14 millim. in diameter.

Compared with the already known forms of *Trophon*, our fossil agrees most with the shell figured by Tryon (vol. II, pl. 31, fig. 326) as *Trophon clavatus* Sars from Norway with this difference that it grows larger and the canal is a little bent instead of being quite straight.

Fusus candelabrum Ad. et Rve (Tryon, vol. II, pl. 31, fig. 317), *Trophon gunneri* Loven Harmer, Plioc. Moll. Grt. Brit., I, pl. XII, fig. 26) and *Trophon gracilis* Arnold (Pal. a. Stratigr. Mar. Plioc. a. Pleistoc. of San Pedro, California, pl. V, fig. 8) are also closely related forms, though less slender than the Japanese shell.

The specimen shown in fig. 2, pl. III is a young shell, while those shown in figs. 13 and 14, pl. VI, are older. Fig. 13 has the lower part of the outer lip slightly broken.

Fossil occurrence.—Miyata-Zone (Maruyama-no-Saka in Shimo-Miyata). Upper Musashino of Kazusa.

53. **Trophon nipponicus**, Yokoyama.

Pl. III. Figs. 13, 14.

Shell small, fusiform, with the height a little less than double the diameter: whorls five or six, convex, distinctly angulate in the middle, and furnished with rather ridge-like longitudinal ribs which number fifteen to seventeen on the body-whorl; body-whorl ventricose, somewhat longer than the spire; aperture ovate: canal slightly bent or almost straight, narrow, rather long.

This species is closely akin to *Trophon multicostatus* Esch. (Arnold, Pal. a. Str. San Pedro, p. 251, pl. VI, fig. 9) and *Trophon scalariformis* Gld (Arnold, pl. VI, fig. 10, Wood, Crag Moll. Univ. I, p. 48, pl. VI, fig. 7, Suppl., p. 21, pl. III, fig. 10). But it seems to be distinguished from both by distinctly angulated whorls. Besides, *Trophon multicostatus* has a more slender shape and a less number of ribs (up to about thirteen), while *Trophon scalariformis* shows a longer and bent canal.

The largest of our specimens measures about 9 millim. in diameter.

Fossil occurrence.—Kanazawa Zone (Nojima and Teramae); Koshiba Zone (Koshiba).

54. **Trophon muricatoides**, Yokoyama.

Pl. III. Fig. 17.

Shell small, fusiform, moderately thick; whorls very convex separated by very deep sutures, longitudinally ribbed and spirally striated; ribs rounded, strong on the upper whorls, but almost obsolete on the body-whorl, separated by intervals of less breadth, about thirteen in number on the penultimate whorl; spiral striæ or threads equal, distant, five on all the whorls except the body-whorl which has in addition more than seven on the base, which are, however, somewhat finer; between these threads there are invariably one or a few very fine interstitial lines. Aperture inverted flask-shaped, with a short, somewhat bent canal. Inner lip smooth. Outer lip thickened, smooth within.

There is only a single specimen lacking the apex. The

whorls preserved are five, but their original number seems to have been at least three more. The height, if perfect, would be about 13 millim; the diameter or breadth is 5 millim.

This species has a great resemblance to *Trophon muricatus* (Mont.) of the North Atlantic (Forbes and Hanley, British Moll., vol. III, p. 439, pl. CXI, figs. 3, 4) and of the English Crag (Wood, Crag Moll., Univ., p. 50, pl. VI, fig. 5), but is chiefly distinguished from it by the ribs becoming obsolete on the body-whorl and the inner lip being smooth within.

Fossil occurrence.—Miyata Zone (Yamagayado in Kami-Miyata).

55. **Trophon inermis**, (Sowerby).

Pl. III. Figs. 21–26.

Trophon inermis. Kobelt in Syst. Conch. Cab. Martini u. Chemnitz, vol. III, pl. 2, Purpurschnecken, p. 287, pl., 71, fig. 12. Tryon, Man. Conch., vol. II, p. 119, pl. 36. fig. 417.

Murex inermis. Sowerby, Proc. Zool. Soc. London, 1840, Conch. Ill. fig. 87. Reeve, Conch. Icon. sp. 152.

Shell rather solid, moderate in size, angulate-fusiform; whorls eight, shouldered, with shoulders angular; surface above the shoulders obliquely sloping, smooth, surface below them perpendicular, with one, rarely two, spiral threads, while on the body-whorl there are six to seven such threads with fine interstitial spiral lines; threads as well as lines may be very indistinct and nearly obsolete. Varices more or less lamellar, spiny at the shoulders usually decreasing in number from the upper whorls to the lower, there being generally four or five on the body-whorl, but rarely up to eight in which case the number remains tolerably constant on all the whorls. Points of intersection of varices and spiral threads on the body-whorl often elevated into blunt teeth. Aperture oval, slightly angular at the posterior corner. Canal moderate in length, narrow, open, somewhat bent. Inner lip smooth, covered by a thick callus with its outer edge usually free. Below the callus and by the side of the canal, there is often a short tubular process oblique or parallel to the latter and formed by the folding of the outer shell-layer. Outer lip thickened by an external varix, smooth within. Proportion of height to breadth

(diameter) varying, 10:3,2–4.1. The largest specimen measures about 45 millim. in height.

This is a very variable species, some specimens being much more slender than others. Also the number of varices on the body-whorl varies from four to eight. Also the spiral threads are sometimes so indistinct as hardly to be visible, while in others they are unusually distinct. The length of the canal is also not constant. All these variations can be observed in hundreds of specimens found at Koshiba.

Sowerby in describing this species had an example with six varices.

Fossil occurrence.—Yokosuka Zone (Yokosuka); Kanazawa Zone (Kanazawa); Koshiba Zone (Koshiba).

Living.—Japan (Sowerby). This species seems to be rare at present, for I have never seen it in our conchological collections.

Genus ***Purpura***. Bruguière.

56. **Purpura luteostoma**, (Chemnitz).

Pl. III. Fig. 27.

Purpura luteostoma. Küster in Syst. Conch. Cab. Mart. u. Chemn., vol. III, pt. 1, p. 107. Lischke, Jap. Meeresconch., I, p. 54, II, p. 39. Pilsbry, Cat. Mar. Moll. Jap., p. 44.

Purpura bronni. Dunker, Moll. Jap., p. 5, pl. I, fig. 23. Lischke, Jap. Meeresconch., I, p. 53, pl. V, fig. 17, II, 39, pl. IV, fig. 20.

Buccinum luteostomum. Chemnitz, Conch. Cab. 11, p. 83, pl. 187, fig. 1800, 1801.

Two broken specimens which, however, exactly agree with those figured by Dunker and Lischke as *Purpura bronni*. This *Purpura bronni* is, according to Tryon (Man. Conch., II, p. 163,) identical with *Purpura tumulosa* Reeve, while Pilsbry (Cat. p. 44) unites it with *Purpura alveolata* Reeve which he says is synonymous with *Purpura clavigera* Küst., and *Purpura tumulosa* Lischke. From this we see that there is a great deal of confusion among the Japanese *Purpurae* of this group. And this, I am sure, arises from the fact that these so-called different species pass insensibly into one another. But in the systematic conchology we must draw a line of demarcation somewhere; therefore following Pilsbry, I include *Purpura bronni* among *Purpura luteostoma* and treat it as a separate species from the following one.

Fossil occurrence.—Yokosuka Zone (Yokosuka and Otsu).

Living.—Northern, Central and Western Japan. East coast of Africa.

57. Purpura alveolata, Reeve.

Pl. III. Fig. 16.

Purpura alveolata. Reeve, Conch. Icon., vol. III, spec. 60, pl. XI, fig. 60. Dunker, Index Moll. Mar. Jap., p. 40. Pilsbry, Catal. Mar. Moll. Japan, p. 44.

Purpura clavigera. Küster in Syst. Conch. Cab. Mart. u. Chemn., vol. III, pt. 1, p. 186, pl. 31 a, fig. 1. Lischke, Jap. Meeresconch., vol. I, p. 54, pl. V, figs. 12–14.

Purpura tumulosa. Lischke, Jap. Meeresconch., vol. I, p. 56, pl. V, figs. 15, 16.

Two young specimens partly broken, but agreeing with those figured by Lischke as *Purpura clavigera* and *Purpura tumulosa*, which surely are mere synomyms of *Purpura alveolata* Reeve. Tryon considers this latter species as a variety of *Purpura hippocastaneum* Lam. (Man. Conch., II, p. 162), an opinion which I am not at all against, for this group of *Purpura* as above stated is vary variable in form.

Fossil occurrence.—Yokosuka Zone (Yokosuka): Naganuma Zone (Naganuma).

Living.—Central and Western Japan, Chile, Panama.

Family Tritonidæ.

Genus *Triton*, Montfort.

58. Triton (Priene) oregonensis, Redfield.

Pl. III. Figs. 19, 20.

Triton oregonensis. Redfield, Ann. Lyc. Nat. Hist. New-York, 1846, vol. 4, p. 165, pl. XI, Fig. 2 ab. Lischke, Jap. Meeresconch., vol. III, p. 31. Küster in Syst. Conch. Cab. Mart. u. Chemn., p. 247, pl. 66, fig. 2. Dunker, Index Moll., p. 30.

Tr tonium cancellatum. Middendorff, Mal. Ross. II, p. 164, pl. III, figs. 1, 2. Schrenck, Nordjap. Moll., p. 431.

Tritonium oregonense. von Martens, Mal. Blätter., XIX, 1872, p. 30. H. and A. Adams, Genera, vol. I, p. 104.

Priene oregonensis. A. Adams in Journ. Proc. Linn. Soc., 1864, vol. VII, p. 106. Pilsbry, Cat. Mar. Moll. Japan, p. 47.

There are numerous specimens of this beautiful species, but not a single large one in perfect preservation. It is easily recognized by its broadly fusiform shape, rounded whorls, many

nodulous longitudinal ribs, numerous, unequal spiral riblets or threads, thickened outer lip, a tubercle-like process on the inner lip near the posterior angle of the aperture and short recurved canal.

Fossil occurrence.—Kamakura Zone (Kewaizaka in Kamakura); Kanazawa Zone (Nojima); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living.—Northern Japan; Alaska; Oregon; Chile; Strait of Magellan.

59. **Triton subpyrum**, Yokoyama.

Pl. IV. Figs. 3, 4.

Shell subpyriform, swollen, thick, with spire low, much shorter than the body-whorl. Whorls very weakly angulated in the middle, the angle being sometimes indistinct. The surface above the angle sloping, while below it is perpendicular, except on the body-whorl in which the shell tapers anteriorly. There are four distinct varices in all, the most anterior one bounding the outer lip from outside; these are elevated, broad and round-topped. Between every two varices, there are usually five broad rounded ribs, indistinct near the upper suture and separated by broad and shallow valleys. The whole surface is also spirally grooved, with grooves numerous, narrow, at irregular intervals, but arranged in such a way as to enclose broader spaces at certain intervals. On this account the surface appears to be ornamented with spiral threads and broader belts. These threads and belts are again crossed by numerous fine longitudinal grooves, making them appear granulate. Aperture subrhombic, with a shallow posterior sinus. Inner lip callous, with many, close, unequal transverse striæ, which become more separate towards the anterior canal. Outer lip with coarse distant transverse folds within. Canal moderate, with narrow opening and bent back. Rare.

The number of whorls seems to be about eight or nine, but the apex is broken.

This species is closely related to *Triton pyrum* Linné (Syst Conch. Cab. Mart. u. Chemn., vol. III, pt. 2, p. 211, pl. 59,

figs. 4, 5) from Ryukyu, Philippines, etc., but the whorls are not so sharply shouldered and the so-called triangular tubercles of the shoulders are wanting.

Fossil occurrence.—Naganuma Zone (Naganuma).

Family **Doliidæ.**

Genus ***Dolium***, LAMARCK.

60. **Dolium luteostomum**, KÜSTER.

PL. IV. FIG. 2.

Dolium luteostomum. KÜSTER in SYST. Conch. Cab. Mart. u. Chemn., vol. III, pt. 1, B, p. 66, pl. 58, fig. 2. LISCHKE. Jap. Meeresconch., vol I, p. 65, II, p. 57. BRAUNS, Geol. Env. Tokio, p. 60. TOKUNAGA, Foss. Env. Tokyo, p. 17, pl. I, fig. 30. PILSBRY, Cat., p. 49.
Dolium japonicum. DUNKER, Novitates Conchologicæ, p. 104, pl. 35, fig. 36.
Dolium variegatum. SCHRENCK, Moll. d. Amurl. u. d. nordjap. Meeres, p. 403.

This shell which becomes very large is characterized by its swollen form, very large body-whorl, deep canal like sutures, broad flatly rounded spiral ribs (four or five on the penultimate and sixteen on the ultimate whorl in our fossil specimens) separated by interspaces of a less breadth, large semi-circular aperture, a narrow umbilicus, thin wavy outer lip, etc. The fossils are all of a young state, the largest measuring only 90 millim. in height.

Pretty frequent.

Fossil occurrence.—Miyata Zone (Harashita in Shimo-Miyata, Kami-Miyata and Motowada); Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma). Upper Musashino of Kazusa, Shimosa and Musashi.

Living.—Northern, Central and Western Japan; Indian Ocean (KÜSTER).

Family **Cerithiidæ.**

Genus ***Cerithium***, ADANSON.

61. **Cerithium kobelti**, DUNKER.

PL. IV. FIG. 10.

Cerithium kobelti. DUNKER, Malak. Blätter, vol. 24, p. 67. Index Moll. Mar. Jap., p. 106, pl. IV, figs. 8, 9.

We possess three badly preserved specimens of this well characterized species. The whorls number eight to nine and are

longitudinally plicate and spirally threaded, the points of intersection of the plicæ and threads being more or less tubercular. Among the many spiral threads, there are two especially large ones which may be close together or rather distant. In our fossil specimens these two threads are pretty close to each other, the upper being nearly in the middle of the whorls and forming an angle above which the surface is obliquely ascending. The plicæ become occasionally varicose. The figured specimen which has eight whorls measures 20 millim. in height and 8,5 millim. in breadth. It lacks the other lip.

Fossil occurrence.—Yokosuka Zone (Otsu).

Living.—Central Japan.

Genus ***Bittium*** (Leach), Gray.

62. **Bittium perpusillum,** Tryon.

Pl. IV. Fig. 13.

Bittium perpusillum. Tryon, Man. Conch., IX, p. 154, pl. 30, fig. 17.

Bittium pusillum. Dunker, Moll. Jap., p. 11, pl. II, fig. 6. Pilsbry, Cat. Mar. Moll. Japan, 56.

The shell is small, turreted, of eight to nine volutions which are slightly convex, separated by deep sutures and spirally costellated. The costellæ number four, of which the uppermost is the smallest and the lowest the largest, and are more or less tuberculated. The longitudinal subplication mentioned by Dunker is only very faintly indicated in some specimens, while others are entirely devoid of such a sculpture. The number of costellæ of the body-whorl above the periphery is usually more than those of the upper ones, being up to seven of which the uppermost ones are sometimes much smaller than the lower ones which near the periphery may be almost smooth and devoid of tubercles. Aperture oval. Canal very short, channel-like. Height 7 millim.; diameter 2,5 millim. Not rare.

This species which was first described by Dunker under the name of *Bittium pusillum* has been renamed by Tryon, as the name *pusillum* is preoccupied by Gould.

Fossil occurrence.—Yokosuka Zone (Yokosuka).
Living.—Western Japan (Dunker).

63. **Bittium binodulosum,** Yokoyama.

Pl. IV. Fig. 8.

Shell small, high-turrete; whorls nine, the first two belonging to the embryo, subconvex, longitudinally plicate and spirally striated; plicæ about eleven on the body-whorl, not quite reaching to the upper suture nor to the lower, strong, rounded, separated by interspaces of usually a less breadth; spiral striæ unequal, the uppermost one or two being in a somewhat concave surface above the plicæ and just below the upper suture, the larger ones two in number, crossing the plicæ, making the crossing-points nodulous. The body-whorl has several striæ down to the base, about seven in number and gradually diminishing in size downwards. Periphery rounded. Sutures distinct. Aperture subrhombic, below produced into a short channel. Inner lip concave; outer lip thin. Height 7 millim. Diameter 3 millim.

A single specimen.

Fossil occurrence.—Koshiba Zone (Koshiba).

Genus ***Potamides.*** Brongniart.

64. **Potamides (Tympanotonos) fluviatilis** (Potiez et Michaud).

Pl. IV. Fig. 14.

Potamides fluviatilis. Lischke, Jap. Meeresconch., I, p. 76. II, 69. Pilsbry, Cat. Mar. Moll. Japan., p. 57. Tokunaga, Foss. Env. Tokyo, p. 25, pl. I, fig. 52.

Tympanotonos fluviatilis. Dunker, Index Moll., p. 110.

Cerithium fluviatile. Potiez et Michaud, Cat. d. Moll. de Douai, p. 363. pl. 31, figs. 19, 20. Sowerby, Thes. Conch., II, p. 891, pl. 186, figs. 296, 298.

Tryon says of this species as follows:

"Whorls flattened, with deeply incised suture, each with three flat-topped spiral ribs, tuberculated in longitudinal rows, tubercles obsolete on the back of the body-whorl except a sutural row, base spirally ridged; aperture in the adult expanded, angularly produced above, oblique, outer lip produced below."

There is a single specimen, a little over 30 millim. in height and 10 millim. in diameter lacking the outer lip, which, however, exactly agrees with the above description.

Fossil occurrence.—Yokosuka Zone (Otsu); Upper Musashino of Shimosa and Musashi.

Living.—Central and Western Japan; Philippines; Australia; India.

65. **Potamides (Batillaria) multiformis,** (Lischke).

Pl. IV. Fig. 9.

Potamides (Batillaria) multiformis. Pilsbry, Catalogue Mar. Moll. Japan, p. 57.

Lampania multiformis. Lischke, Jap. Meeresconch., vol. I, p. 74, pl. VII, figs. 1–10, II, p. 69. Dunker, Index Moll., p. 109. Tryon, Man. Conch., IX, p. 167, pl. 35, fig. 13, pl. 34, figs. 6, 8.

This species is readily distinguishable from the preceding by its shorter form, weak longitudinal folds and many unequal spiral ribs. The body-whorl is very large, occupying one-third to one-half of the height of the shell. The aperture is very wide, and ovate with the outer lip describing an arc of a large circle.

Frequent.

Fossil occurrence.—Yokosuka Zone (Yokosuka and Otsu). Upper Musashino of Kazusa and Shimosa.

Living.—Northern, Central and Western Japan

Family **Cerithiopsidæ.**

Genus ***Triforis,*** Deshayes.

66. **Triforis otsuensis,** Yokoyama.

Pl. IV. Fig. 11.

A single specimen.

Shell small, subulate, many whorled; whorls flat, with three close rows of tuberculated spiral riblets of which the middle one is weaker than the other two, except on the body-whorl in which they are all of equal size and accompanied below by another untuberculated riblet which forms an angular periphery. Base flattened with a few spiral ridges. Canal short, pointed.

The number of whorls must have been more than ten, but the upper part of the shell being broken, it is not possible to tell it exactly. The outer lip is also broken. The number of tubercles which are close together is about twenty on the body-whorl.

This species is somewhat like *Triforis cingulata* Dunker (Moll. Jap., pl. II, fig. 1) which is, however, not tuberculated. *Triforis alveolatus* A. Adams (Voy. Samarang, pl. XI, fig. 30) also seems to be related to this species, but its riblets are all of equal size.

Fossil occurrence.—Yokosuka Zone (Otsu). Upper Musashino of Kazusa.

Living.—Central Japan.

Family **Trichotropidæ.**

Genus ***Trichotropis***, Broderip et Sowerby.

67. **Trichotropis planicostata**, Yokoyama.

Pl. IV. Fig. 6.

Shell small, thin, turbinate; whorls five, spire short and acute, body-whorl very large; whorls of the spire convex, shouldered, spirally costellated, costellæ flat-topped, distant, four in number, the upper two being weaker than the lower ones and the shoulders being formed by the second one from below; the surface above shoulders is obliquely ascending; on the body-whorl the shoulder is not so distinct and the surface above it is more horizontal, the surface below it is strongly convex with seven distant and equal spiral costellæ down to the base, and an interstitial spiral thread between the shoulder-costella and the one below it. Interspaces between the costellæ partitioned off into rectangular pits by more or less distant rounded longitudinal threads which do not cross the costellæ. Aperture very large, broadly oval, with peristome continuous and a faint indication of a channel in front. Outer lip thin. Umbilicus small, deep. Height 11 millim. Diameter 9 millim. A single example.

Fossil occurrence.—Koshiba Zone (Koshiba).

Family **Vermetidæ.**

Genus ***Thylacodes.*** GUETTARD.

68. **Thylacodes medusæ,** PILSBRY.

PL. IV. FIG. 7.

Thylacodes medusæ. PILSBRY, Proc. Acad. Nat. Sci., Philad., 1891, p. 471, pl. 17, 18. Cat. Mar. Moll. Jap., p. 59, pl. IV and V.

This species is characterized by PILSBRY as having "narrow longitudinal cords at rather wide intervals, the spaces between being occupied by a variable number of threads, (usually three) of which the middle one is the largest." And this sculpture is normally "developed upon all sides of the tube," though upon the latter part of the free portion it is often subobsolete." The cross-section of the adult tube is circular. Rather frequent, though mostly in fragments.

Fossil occurrence.—Miyata Zone (Shimo-Miyata); Yokosuka Zone (Yokosuka). Upper Musashino of Kazusa.

Living.—Central Japan (Suruga).

Family **Turritellidæ.**

Genus ***Turritella,*** LAMARCK.

69. **Turritella nipponica,** YOKOYAMA.

PL. IV. FIGS. 16–19.

Shell high-turrete; whorls numerous, nearly flat, slightly angulated a little above the sutures, spirally ribbed; ribs normally five, one which is suprasutural being usually not prominent except on the body-whorl. Of the four upper ribs, the lower two are stronger than the upper two; the two stronger ones of which the lower forms the angle generally flat-topped, while the two weaker ones are usually sharp and ridge-like, though sometimes they may also be flat-topped. In abnormal cases, the number of ribs may altogether be six instead of five (either the stronger or the weaker ribs becoming three), in which case the weak suprasutural one may also become prominent. The spaces between the ribs are either smooth or spirally striated, the striæ often appearing also

on the ribs themselves. On the body-whorl below the angle-rib, there are a few spiral ribs often with interstitial spiral striæ. Base flatly convex. Aperture roundish.

The specimens are numerous, but the adult ones are mostly broken, so that it is very difficult to ascertain the number of whorls. But judging from the more perfect younger ones, they must have been at least fifteen. The largest specimen measures about 14 millim. in diameter. The height of such specimens might be estimated at about 60 millim.

This species is related to *Turritella facialis* Menke (Tryon, Man. Conch., vol. 8, pl. 59, figs. 36, 37) which is, however, four-ribbed. *Turritella bacillum* Kiener (Tryon, pl. 59, figs. 34, 35) which is also akin to our species has six ribs and convex whorls.

Fossil occurrence.—Miyata Zone (Kami-Miyata), rare; Kanazawa Zone (Nojima and Kanazawa), very frequent; Koshiba Zone (Koshiba), also very frequent; Naganuma Zone (Naganuma and Sugita), rare.

Family Solariidæ.

Genus *Solarium*, Lamarck.

70. Solarium lenticulatum, Yokoyama.

Pl. IV. Fig. 21.

Shell small, lenticular, rather solid; spire very flatly conical; whorls about five, somewhat convex, spirally striated; striæ about six on the penultimate whorl, unequal, the lowest one close to the suture being the largest, with a shallow, but comparatively wide furrow between this lowest and the next one; in this furrow there is a fine spiral line which may grow into the size of the other striæ, in which case, the furrow becomes more or less indistinct. Lines of growth coarse, their points of intersection with the striæ being more or less granulated. Periphery angulate, and finely crenulate. Base convex, outer half with several spiral striæ, inner half with very coarse growth-lines which appear like radiating striæ. Umbilicus large, deep, with margin crenulated, sur-

rounded by a spiral groove, or not. Aperture subangulated at the outer side.

We possess two specimens, both with the outer lip broken. The larger measures 6 millim. in height and 11 millim. in diameter, and is much water-worn; the smaller measures 5 millim. in height and 9 millim. in diameter and has the sculpture better preserved.

Fossil occurrence.—Koshiba Zone (Koshiba).

Family **Rissoidæ.**

Genus ***Rissoina***, d'Orbigny.

71. **Rissoina submerculialis**, Yokoyama.

Pl. IV. Fig. 15.

Shell small, turreted with apex bluntly pointed and base rounded. Whorls eight, slightly convex, separated by deep impressed sutures, the first two smooth, the others longitudinally ribbed; ribs somewhat oblique, elevated, with rounded ridges and somewhat wider intervals, nineteen on the body-whorl, the last growing into a strong, rounded varix on the back of the outer lip. Base with a strong, rounded, transverse or rather spiral cord which is longitudinally costellated. Aperture semilunar, anterior angle with a shallow notch. Inner lip smooth, slightly concave. Outer lip thickened by the dorsal varix. Height 4,5 millim. Diameter 1,5 millim.

A single example.

This shell is much like *Rissoina mercurialis* Watson (Challenger Gastropoda, p. 619, pl. XLVI, fig. 8) from Cape York in Australia, but in the latter, the ribs are less (fifteen on the body-whorl) and the interspaces transversely striated, while in the former they are smooth.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

72. **Rissoina zeltnerioides**, Yokoyama.

Pl. IV. Fig. 20.

Shell small, solid, turreted, bluntly pointed at apex, rounded at base. Whorls about six and a half, somewhat convex, the first

one and a half smooth, the others very finely obliquely striated, with striæ slightly sinuous and covering the whole surface, not even the base excepted. No spiral sculpture. Mouth subsemilunar, inner lip slightly concave, outer lip thickened. Height 3.5 millim. Diameter 1,3 millim.

A single specimen.

This species closely resembles *Rissoina zeltneri* Folin (Tryon's Man. IX, pl. 68, fig. 19) living at Panama, the resemblance is so close that the one may possibly prove to be a variety of the other. The distinctions of the Panama species are the more protruding outer lip, the presence of spiral striæ on the base in lieu of oblique ones, and perhaps also a greater number of whorls.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

Genus ***Fenella***, A. Adams.

73. **Fenella orientalis**, Yokoyama.

Pl. IV. Fig. 12.

The shell is very small, turreted with about nine convex whorls which are longitudinally and also spirally costellated. The longitudinal costellæ are twelve to thirteen on the body-whorl, distant and sharp. The spiral ones are usually four in number, the upper two fine and striæ-like, while the lower two are stronger and roof-shaped, so that the surface above them as well as below them is obliquely receding. On the body-whorl the longitudinal costellæ end at the angulated periphery, the base showing only spiral striæ which get smaller and smaller as we go to the bottom of the base. Aperture more ovate than circular. Outer lip thin, without crenulations.

There are two specimens, of which the smaller is more perfect. It is 3,7 millim. in height and 1,2 millim. in diameter.

This species resembles *Fenella elongata* Watson (Challenger Gastropoda, p. 621, pl. 34, fig. 4) from the West Indies which, however, has more whorls. A shell described as *Dunkeria falcifera* by Watson (Chall. Gastr., pl. 34, fig. 5) also from the West Indies also resembles the Japanese shell, but it has only two spiral threads.

Fossil occurrence.—Yokosuka Zone (Yokosuka).
Living.—Central Japan.

Family **Skeneidæ.**

Genus ***Skenea.*** FLEMING.

74. **Skenea nipponica,** YOKOYAMA.

PL. V. FIG. 1.

A few specimens of a very small shell, only 2 millim. in diameter, smooth, almost discoidal, having a few quickly growing whorls with subconcave base and a deep open umbilicus. Aperture obliquely oval.

This species is allied to *Skenea planorbis* (FABR.) (FORBES and HANLEY, Brit. Moll., III, p. 156, pl. XXIV, figs. 1–3) of the northern seas, from which it is, however, distinguished by a somewhat flatter shell, more quickly growing whorls and a smaller umbilicus.

Fossil occurrence.—Yokosuka Zone (Otsu). Upper Musashino of Shimosa.

Living.—Central Japan.

Family **Capulidæ.**

Genus ***Calyptræa,*** LAMARCK.

75. **Calyptræa mammilaris,** (BRODERIP).

PL. IV. FIG. 5.

Calyptræa mammilaris. TRYON, Manual of Conchology, vol. VIII, p. 120, pl. 34, figs. 64–75, 78–81.

Trochita mammilaris. SOWERBY, Thes. Conch., V, p. 65, pl. 450, figs. 69–71.

A specimen of a flatly conical spiral shell nearly circular in outline, about 4 millim. in height and 9 millim. in diameter, with a spiral diaphragm within, whose columellar margin is twisted, undoubtedly belongs to the above-named species. The apex is subcentral, and the surface is roughly and unequally concentrically striated.

Fossil occurrence.—Miyata Zone (Kami-Miyata). Upper Musashino of Kazusa.

Living.—West coast of America from Puget Sound down to the Strait of Magellan.

Genus ***Crepidula***, Lamarck.

76. **Crepidula orbella**, Yokoyama.

Pl. IV. Figs. 22, 23.

Shell small, thin, somewhat variable in shape being roundly quadrate to roundly ovate in outline, flatly convex; apex small, spiral, posterior, marginal: surface with concentrical rugose lines of growth; septum posterior, concave on both sides of a blunt median ridge; the greatest diameter 7 millim. Three specimens.

A. Adams described a species of *Crepidula* from Goto (Kyushu) under the name of *C. lamellosa* (Ann. Mag., 1862, p. 297) without any figure. It seems to resemble this fossil form, but Adams says that the dorsal side of the shell is lamellar and imbricate, so that the two can not be quite identical.

Fossil occurrence.—Naganuma Zone (Naganuma).

Family **Naticidæ.**

Genus ***Natica***, Adanson.

77. **Natica janthostoma**, Deshayes.

Pl. V. Figs. 3, 4.

Natica janthostoma. Deshayes, Revue Zool., p. 361. Lischke, Jap. Meeresconch., I, p. 81. Dunker, Index Moll. Mar. Jap., p. 61. Philippi in Syst. Conch. Cab. Mart. u. Chemn., vol. II, Abt. 1, Natica u. Amaura, p. 53, pl. 8, fig. 8. Pilsbry, Cat. Jap. Moll., p. 71.

Natica clausa var. jathostoma. Middendorff, Mal. Ross. II, p. 209. Schrenck, Moll. Amurl. u. d. Nordjap. Meeres, p. 373. Tryon, Man. Conch., vol. VIII, p. 31, pl. 19, fig. 89.

Natica clausa. Tokunaga, Foss. Env. Tokyo. p. 17, pl. I, fig. 31.

The shell is globose, somewhat higher than broad, consisting of about six whorls, which are often flattened below the suture. The growth-lines are distinct, crossed in some instances by very fine spiral lines most conspicuous below the suture. The aperture is semilunar with the posterior corner subangular and the anterior rounded. The callus is semi-circular and flat, and closes the umbilicus, but always with a more or less deep groove surrounding it on the rounded side.

This species is united by many authors with *Natica clausa* Brod. et Sow. whose typical specimens have the callus continuous with the surrounding surface and not separated by a groove as in our species. Our fossil forms all exhibit the character of *N. janthostoma* Desh.

Widely spread as fossils, and often frequent.

Fossil occurrence.—Miyata Zone (Kami-Miyata, Maruyama-no-Saka and Mukaibatake in Shimo-Miyata, and Nagai; Yokosuka Zone (Otsu and Yokosuka); Kamakura Zone (Kewaizaka in Kamakura); Kanazawa Zone (Nojima); Koshiba Zone (Koshiba); Naganuma Zone (Iijima, Kikkōzan and Naganuma). Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern and Central Japan; Kamchatka.

Genus ***Pollinices***, Montfort.

78. Pollinices pallidus, (Broderip et Sowerby).

Pl. IV. Fig. 1.

Pollinices pallidus. Pilsbry, Cat. Mar. Moll. Jap., p. 72.

Nati a pallida. Broderip et Sowerby, Zool. Journ., vol. IV, p. 372. Middendorff, Mal. Ross, II, p. 92. Schrenck, Moll. Amurl. u. d. Nordjap. Meeres, p. 375. Tryon, Man. Conch., VIII, p. 37, pl. 94, figs. 76–78, pl. 13, fig. 15, pl. 14, figs. 26–28.

This species resembles the preceding in the general form of the shell, but is distinguished from it by the narrow open umbilicus and corneous operculum. Our specimens are on an average smaller than those of *Natica janthostoma*, the largest measuring 17 millim. in height and 15 millim. in the greatest diameter. Not rare.

Fossil occurrence.—Koshiba Zone (Koshiba).

Living.—Circumpolar; Sea of Okhotsk.

79. Polinices (Neverita) ampla, (Philippi).

Pl. V. Figs. 5, 6.

Pollinices (Neverita) ampla. Pilsbry, Cat. Mar. Moll. Jap., p. 72.

Natica ampla. Philippi, Zeitschr. f. Malak., 1848, p. 156. Tokunaga, Foss. Env. Tokyo, p. 18, pl. I, pg. 32.

Neverita ampla. Tryon, Man. Conch., VIII, p. 32, 10, figs. 51–83, 85, 86, pl. 11, figs. 91–93, pl. 12, fig. 6.

Neverita vesicalis. Dunker, Index Moll. Mar. Jap., p. 61.

Natica robusta. Dunker, Moll. Jap., p. 13, pl. II, fig. 24

Nati a licolor. Schrenck, Moll. Amurl. u. d. Nordjap. Meeres, p. 378.

Natica lamarckiana. Lischke, Jap. Meeres-Conch., 1, p. 80. Brauns, Geol. Env. Tokio, p. 30.

This species, when compared with the foregoing ones, has flatter whorls, the more obliquely receding aperture and the shell growing to a larger size. The callus has various shapes, sometimes very large so as to cover the whole umbilicus or, as is more usually the case, small and leaving a greater or less part of the umbilicus open, but in every case it has always a transverse groove running across its surface. The spire may be elevated or somewhat depressed; when elevated it approaches a conical shape, as the whorls of the spire are more or less flattened.

Fossil occurrence.—Miyata Zone (Okine Nagai); Yokosuka Zone (Yokosuka and Otsu); Naganuma Zone (Naganuma); Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Central Japan; China; Australia; Indian Ocean.

Family Scalaridæ.

Genus *Scalaria*, Lamaick.

80. Scalaria turriculoides, Yokoyama.

Pl. V. Fig. 12.

Shell small, rather thin, turrete; whorls about seven, very convex, longitudinally ribbed; ribs somewhat oblique and curved, thick, elevated, many (about fifteen on the penultimate whorl) separated by intervals of a little greater breadth which are ornamented with very fine spiral lines only observable with a strong lens; some of the ribs are specially large and thick so as to appear like varices. Aperture quite circular, continuous, thickened and flattened at margin. Umbilicus covered. A single specimen measuring 12 millim. in height and 5 millim. in the greatest diameter.

This species is closely allied to *Scalaria turricula* Sow. (Thes. Conch., I, Scalaria, p. 92, pl. XXXIII, fig. 61, pl. XXXIV, fig, 88) originally from the West Indies, but reported by Sowerby also from the Strait of Corea. But the fossil form has closer and thicker ribs than the living.

Fossil occurrence.—Koshiba Zone (Koshiba).

81. **Scalaria (Acrilla) densicostata,** Yokoyama.

Pl. V. Fig. 14.

Scalaria immaculata. Tokunaga Foss. Env. Tokyo. 19, pl. I. fig. 35. Not *Sc. immaculata.* Sow.

Shell small, thin, turrete, whorls about nine, contiguous, very convex, longitudinally ribbed and spirally finely striated; ribs rather thick, not much elevated, obtuse, straight, numerous (about twenty-five on the penultimate whorl), with equal or, as is more usual, broader interspaces. Body-whorl somewhat keeled at periphery, below which the ribs are obsolete and substituted by coarse, unequal longitudinal lines. Aperture oval, angulated behind, rounded and slightly curved out in front. Outer lip thin.

There are only two examples; the one has only three lower whorls preserved and measures 7,5 millim in diameter, while the other which is smaller but more complete is about 15 millim. in height and 5 millim. in diameter.

Tokunaga described this species from the Upper Musashino of Oji under the name of *Scalaria immaculata* Sow. (Thes. Conch., I, Scalaria, p. 93, pl. XXXIII, fig, 58) which lives in Central Japan, but the Sowerby species has very thin ribs which disappear about the middle of the whorls and is quite a different form.

Fossil occurrence.—Koshiba Zone (Koshiba); Upper Musashino of Musashi.

Family **Bulimidæ.**

Genus ***Eulima,*** Risso.

82. **Eulima (Leiostraca) yokoskensis,** Yokoyama.

Pl. V. Fig. 7.

Shell very small, subulate, with spire somewhat curved, smooth, polished, white and shining; whorls about nine, slightly convex. Aperture ovate, pointed behind and rounded in front. Inner lip a little reflexed outward; Outer lip thin and sharp. Height 5 millim. Diameter 1,5 millim.

This shell resembles *Eulima solidula* Sow. (Voy. Samarang, p. 52, pl. XI. fig. 26) of China Sea, but the aperture is more produced in front. A single specimen.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

83. **Eulima (Leiostraca) sagamiana**, Yokoyama.

Pl. V. Fig. 8.

Shell very small, subulate; Whorls perfectly flat, smooth, glossy; body-whorl large with periphery rounded and base strongly convex. Sutures not very distinct. Aperture ovate, acute behind and rounded in front. Outer lip thin.

The single specimen which we possess lacks the apical portion of the spire. But the number of whorls may have been about seven or eight, with height measuring about 3,5 millim. The diameter as well as the length of the aperture is about 1 millim.

Watson in his Challenger Report described several species of *Eulima* of which *E. acanthyllis* and *E. famelica* seem to be nearest to this fossil form. But the former (Challenger Gastropoda, pl. XXXV, fig. 8) has the inner lip more reflected over the columella and the latter (l. c. pl. XXXVI, fig. 4) has the outer lip protruding out of the straight line drawn from the apex downward on the spire.

Fossil occurrence.—Naganuma Zone (Naganuma).

Family **Pyramidellidæ**.

Genus ***Pyramidella***, Lamarck.

84. **Pyramidella (Tiberia) psendo-pulchella**, Yokoyama.

Pl. V. Fig. 11.

Shell small, elongate-conic, with a spiral zone of brown close to the lower suture, while on the body-whorl there is another band of the same colour on the anterior portion of the base. Whorls about ten, separated by deep impressed sutures, very flatly convex, polished. Periphery somewhat angulated. Base short, rounded. Aperture ovate, angular behind. Outer lip thin. Columella bipicate, the posterior fold much larger than the

anterior which is weak. Height 6 millim. Diameter 2,8 millim. A single specimen.

This shell is closely akin to our living species *Pyramidella pulchella* Adams (Dall and Bartsch, Notes on Jap., Indopac., a. Amer. Pyramidellidae, Proc. U. S. Nat. Mus., XX, p. 323, pl. XXV, fig. 4.), but it is shorter with the whorls a little more convex and sutures deeper.

Fossil occurrence.—Naganuma Zone (Naganuma).

There is a specimen of a *Pyramidella* from Yokosuka 7 millim. high and 3 millim. in diameter exactly like that from Naganuma both in shape and coloring, but distinguished by the somewhat thickened outer lip with three transverse teeth within, of which the lowest is comparatively very small. At first I took it for a different species, but as there is a possibility of its being an abnormal or pathological form, I prefer to treat it for the present simply as a variety under the name of var. *dentata*.

Genus ***Odostomia***, Fleming.

85. Odostomia (Odostomia) hilgendorffi, Clessin.

Pl. V. Fig. 9.

Odostomia hilgendorffi. Clessin in Conch. Cab. Mart. u. Chemn., 2d ed., Pyramidella, 1900, p. 119, pl. XXVIII. fig. 5. Dall a. Bartsch Notes on Jap., Indopac., a. Amer. Pyramidellidæ, Proc. U. S. Nat. Mus., p. 364. pl. XXIV, fig. 5.

This species has been minutely described by Dall and Bartsch in the above mentioned work, but the specimen on which the description was based having had the outer lip fractured, no mention is made of several transverse ridges which line the inner surface of the outer lip at a little distance from the margin. The largest of the fossil specimens which measures about 7 millim. in height shows them very distinctly, while in the smaller ones they are more or less weak. (On the plate, the species has been numbered by mistake as 6, below fig. 8).

Fossil occurrence.—Naganuma Zone (Naganuma).

Living.—Northern Japan (Hakodate).

86. **Odostomia (Parthenina) takinogawensis,** Tokunaga

Pl. V. Fig. 10.

Odo tomia takinogawensis. Tokunaga, Foss. Env. Tokyo, p. 23, pl. I, fig. 45.

Shell small, elongate-ovate, turrete; whorls six, of which two are nuclear and smooth, the others slightly convex, perpendicular, shouldered with shoulders angular and surface above them flat and slightly sloping, longitudinally plicated; plicæ about fifteen on the penultimate whorl, straight, more or less sharp and roof-like, separated by interspaces of nearly equal breadth, reaching from the upper to the lower suture, weaker and finer on the body-whorl, becoming obsolete in its last portion. Periphery rounded. Base convex with continuations of weak longitudinal plicæ and very finely transversely striated (only seen with a magnifying glass). Aperture ovate, with the posterior corner pointed. Outer lip sharp, dentate within. Columella with a strong fold. Height 5 millim. Diameter 2 millim. Two specimens.

Fossil occurrence.—Naganuma Zone (Naganuma); Upper Musashino of Musashi (rare).

87. **Odostomia (Odostomia) sublimpida,** Yokoyama.

Pl. V. Fig. 13.

Shell very small, elongate-conic. Whorls six, flatly convex, separated by deep sutures, smooth. Body-whorl feebly angulate at the periphery. Aperture large, ovate, rounded in front, acute behind. Outer lip thin. Columella with a sharp lamellar fold.

There are two specimens apparently belonging to one and the same species. The one is from Naganuma, which, though larger, has only the last three whorls preserved. The other is from Okine, which, though smaller has the shell perfect. The latter measures 3 millim. in height and 1,5 millim. in diameter.

The species is very much like *Odostomia limpida* Dall and Bartsch (Notes on Jap., Indopac., and Amer. Pyramidellidæ, Proc. U. S. Nat. Mus., vol, XXX, p. 364, pl. 26, fig. 7) also from Japan. But the fossil form, so far as the only perfect specimen from Okine goes, is decidedly shorter with the sutures deeper and the aperture wider.

Fossil occurrence.—Miyata Zone (Okine in Nagai); Naganuma Zone (Naganuma)? Upper Musashino of Shimosa.

Genus ***Turbonilla***, Risso.

88. **Turbonilla (Cingulina) adamsi,** Yokoyama.

Pl. V. Fig. 17.

Shell small, elongate-conic. Nuclear whorls planorboid, standing on edge on the first whorl. Post-nuclear whorls about ten in number, nearly flat and furnished with two deep spiral grooves, dividing the surface into three unequal parts with the uppermost narrowest and the lowest broadest. Body-whorl with a third, somewhat less deep spiral groove at the periphery which is bluntly angulate. Sutures deep. Aperture (fractured) subquadrate in shape.

The largest of a few specimens which we possess measures 7 millim. in height and 1.8 millim. in diameter.

This species is very close to *Turbonilla triarata* Pilsbry (Proc. Acad. Sci., Philad., Jan., 1904, p. 31, pl. V, fig. 48) living in Japan; but the whorls are flatter and the grooves deeper, looking in these respects more like *T. cingulata* Dunk. (ibid., pl. V, fig. 47), also living in Japan, which has, however, three grooves instead of two.

Fossil occurrence.—Naganuma Zone (Naganuma).

89. **Turbonilla (Chemnitzia) subapproximata,** Yokoyama.

Pl. V. Fig. 18.

Shell small, slender, subulate. Whorls many, flatly convex, separated by deep sutures, longitudinally ribbed. Ribs elevated, rounded, with about equal intercostal spaces, nearly straight, reaching from the one suture to the other, ending at the rounded periphery on the body-whorl, about sixteen on the penultimate whorl. Base convex, smooth, with only faint indications of ribs at the outer circumference. Aperture subquadrate, acute behind. Outer lip thin.

A single specimen with only seven whorls preserved with diameter 2 millim. The height, if perfect, would be about 8 millim.

Turbonilla approximata Dall and Bartsch (Notes on Jap., Indopac., a. Amer. Pyramidellidae, p. 337, pl. XX, fig. 1) which closely resembles the present species is distinguished by having more ribs (22 on the penultimate whorl).

Fossil occurrence.—Naganuma Zone (Naganuma).

90. **Turbonilla (Mormula) tokunagai,** Yokoyama.

Pl. V. Fig. 16.

Shell small, slender, turriculate. Whorls fifteen, the nuclear whorls two, of which the first is pushed sidewise, so that it appears to be attached to the lateral surface of the second; post-nuclear whorls flatly convex, longitudinally ribbed. Ribs elevated, with interspaces about double their breadth and very faintly, transversely striated, sixteen on the body-whorl of which the last forms a varix on the back of the outer lip. Periphery rounded. Base without ribs, but provided with a few fine spiral lines. Aperture subquadrate, with the posterior angle acute. Inner lip reflected somewhat outward. Height 8 millim., diameter 1,7 millim. A single specimen.

This shell is somewhat like *Turbonilla aulica* Dall and Bartsch (Notes on Jap., Indopac., and Amer. Pyramidellidae, p. 345, pl. XXII, fig. 7) from Kyūshū, but in the latter the ribs are more numerous and the intercostal spiral striae stronger and more distinct.

Fossil occurrence.—Yokosuka Zone (Otsu).

Family **Turbinidæ.**

Genus ***Turbo,*** Linné.

91. **Turbo (Marmorostoma) coreensis,** Recluz.

Pl. V. Figs. 19, 20.

Turbo coreensis. Recluz, Journ. de conch., 1853, p. 245, pl. 8, fig. 2. Pilsbry, Cat Mar. Moll. Japan, p. 89.

Turbo coronatus var. coreensis. Tryon, Man. Conch., X, p. 217, pl. 47, fig. 19.

Lunella granulata var. coreensis. Dunker, Ind. Moll. Mar. Jap., p. 128.

This species is quite like *Turbo granulatus* Gmelin in form and sculpture, with the only difference of being not umbilicated. On this account, it is often considered as only a variety of the latter.

Four specimens have been collected and also two opercula probably belonging to the same species. These opercula are calcareous, round in outline, convex and granular.

Fossil occurrence.—Yokosuka Zone (Yokosuka and Otsu).

Living.—Central and Western Japan; Corea.

Tokunaga mentions *Turbo granulatus* Gm. among the fossils of Tabata, giving *Turbo coreensis* as its synonym, but nothing is said as to whether the specimens belong to the true *granulatus* or to var. *coreensis*.

Genus ***Leptothyra***, Carpenter.

92. **Leptothyra amussitata**, (Gould).

Pl. V. Fig. 21.

Leptothyra amussitata. Tryon, Man. Conch., X, p. 250, pl. 55, figs. 71, 72. Pilsbry, Cat. Mar. Moll. Japan, p. 90.

Trochus amussitatus. Tokunaga, Foss. Env. Tokyo, p. 29, pl. II, fig. 2.

Turbo amussitatus. Gould, Otia Conchologica, p. 160.

Tryon gives the description of this species as follows:—

"Shell globose-conic, imperforate, solid, uniform deep crimson; sutures deeply impressed; whorls 5, convex, spirally lirate, the liræ large and prominent on middle portion of whorl, alternating with smaller intercalated riblets; base very finely concentrically striate, the whole surface decussated by numerous regular oblique impressed lines in the direction of incremental striæ; last whorl descending anteriorly; aperture subcircular, oblique, less than half the length of shell, silvery within; columella slightly tuberculate at base. Alt. 8–10, diam. 8–10 millim."

Many specimens have been collected in the Yokosuka Zone. Nearly all of them retain more or less the original colour. The intercalated riblets are not always observable, though distinct in some. A specimen from Koshiba which is bleached is the largest, measuring 6 millim. in height and diameter.

Fossil occurrence.—Miyata Zone (Motowada); Yokosuka Zone (Otsu and Yokosuka); Koshiba Zone (Koshiba); Upper Musashino of Musashi.

Living.—Northern Japan (Yamada Bay) and Sakhalin.

93. **Leptothyra purpurescens,** (Dunker).

Pl. V. Fig. 22.

Leptothyra purpurescens. Tryon, Man. Conch., X, p. 251, pl. 69, fig. 24. Pilsbry, Cat. Mar. Moll. Jap., 90.

Collonia purpurescens. Dunker, Index Moll. Mar. Jap., p. 129, pl. XII, figs. 1–3.

This is a globose shell with five rounded whorls separated by subcanaliculated sutures and spirally sculptured by unequal graniferous riblets at unequal distances. Between the riblets there are one or several fine close spiral striæ. The aperture is round and pearly within when living. The purple colour is more or less preserved in our specimens which are in general larger than those of the preceding species, height and diameter being about 11 millim. in the largest one. Rather frequent.

Fossil occurrence.—Miyata Zone (Mukaibatake, Harashita and Maruyama-no-saka in Shimo-Miyata, Kami-Miyata and Motowada). Upper Musashino of Kazusa and Shimosa.

Living.—Japan (Dunker).

94. **Leptothyra** cf. **paucicostata,** Dall.

Pl. V. Fig. 15.

A single imperfect specimen much water-worn and with fractured outer lip. It is a small shell, 8 millim. in height and diameter, depressed-globose, solid and imperforate. The whorls are few, rapidly growing, the last one having two strong, elevated spiral ribs above the angulated periphery separated by concave interspaces. Of these two ribs, the lower one is somewhat larger, while the one forming the periphery is about the same size as the upper rib. The base is flattened near the periphery and ornamented with five spiral threads. The place where the umbilicus ought to be, if it is present, is somewhat sunken. Lines of growth very distinct.

On comparing this species with the living forms figured by Tryon in his Manual of Conchology, it resembles *Leptothyra paucicostata* Dall (vol. X, p. 248, pl. 63, fig. 27) so much, that there is hardly any difference between the two. But our specimen being imperfect, I can not determine it with certainty.

Fossil occurrence.—Yokosuka Zone (Otsu).

Living.—Dall's species lives on the coast of California.

Family **Trochidæ.**

Genus ***Chlorostoma,*** Swainson.

95. **Chlorostoma miyatense,** Yokoyama.

Pl. V. Fig. 33.

Shell small, flatly conical, pointed at apex; whorls about six, of which the first one and a half are nuclear and smooth, the others flatly convex with shallow but broad canaliculated sutures, spirally costellated; costellæ subequal, six on the penultimate whorl with the two uppermost granulate, separated by interspaces of nearly equal breadth which are finely but distinctly cross-striate by incremental lines. Periphery sharply angulated, projecting, crenulate by lines of growth. Base flat, with many unequal spiral threads crossed by lines of growth and appearing granulate. Umbilicus wide, deep, funnel-shaped with surface flat and only with lines of growth and with margin angular and crenulate. Aperture squarely rhombic with breadth somewhat greater than height. Inner lip smooth, the callus being partly spread over the base. Outer lip simple, sharp. The colour of the shell seems to have been white with pink blotches, as the latter are more or less distinctly preserved, though in a faded condition. Height 6 millim., diameter 8.5 millim. Two specimens.

The close ally of this species is *Chlorostoma gundlachi* Phil. (Syst. Conch. Cab. Mart. u. Chemn., vol. I, part III, p. 226, pl. 34, fig. 13) from Cuba which Pilsbry in Tryon's Manual of Conchology (vol. XI, p. 185) considers as an immature form of *C. scalare* Anton. Anyhow, our shell has a sharper periphery and a flatter base.

Fossil occurrence.—Miyata Zone (Kami-Miyata and Maru-yama-no-Saka in Shimo-Miyata).

96. **Chlorostoma quantoanum**, Yokoyama.

Pl. V. Fig. 24.

Shell umbilicate, conoid, rather thick; whorls about six, parted by deep canaliculated sutures, slightly convex in the upper half and somewhat concave in the lower half, closely spirally striated; striæ subequal except the one at a small distance from the lower suture which is much stronger than the others, more than ten in number on the penultimate whorl, crossed by fine incremental lines making them appear finely granulate; the upper edge of the body-whorl coarsely and irregularly though weakly tuberculated. Periphery angular, yet not quite sharp. Base convex, finely and closely spirally striated, crossed by coarse lines of growth. Umbilicus deep, margined by a rounded ridge outside of which and at a little distance from it there is also a spiral cord, though not so large and elevated as the inner ridge. Aperture squarely rhombic, with breadth greater than height. Inner lip covered by a callus which is also partly spread on the inner side of the umbilicus. Height 7 millim. Diameter 10 millim.

The only specimen present is coloured dark-red or purple.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

97. **Chlorostoma tokunagai**, Yokoyama.

Pl. V. Fig. 25.

Shell small, conoid, rather thick; whorls about five, separated by somewhat canaliculated sutures, with four spiral threads except on the last whorl, of which the lowest situated somewhat above the suture is the largest, while the upper three are subequal; the space between the lowest thread and the suture is provided with a few fine spiral striæ; body-whorl provided with many unequal spiral threads, the periphery two-angled being formed by two larger threads somewhat distant from each other and with the interstice concave and spirally striated; above the upper thread of

the periphery, there are still two coarser threads between which there are one to three finer ones. Base convex, with more than ten spiral striæ between which there is an interstitial stria most distinct near the umbilicus which is small and deep. Lines of growth distinct, especially on the base. Aperture squarish (outer lip somewhat fractured). Height 4 millim., diameter 6 millim. The only specimen present is coloured pinkish with blotches of a deeper purple.

This species is easily distinguished from the preceding ones by bicarinated periphery.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

Genus ***Cantharidus***, Montfort.

98. **Cantharidus japonicus**, (A. Adams).

Pl. V. Fig. 26.

Cantharidus japonicus. Pilsbry, Cat. Mar. Moll. Jap., p. 95.
Ziziphinus japonicus. A. Adams, Proc. Zool. Soc. Lond., 1851, p. 167.
Trochus hilaris. Lischke, Jap. Meeresconch., II, p. 85, pl. V, figs. 14, 15.
Calliostoma hilaris. Pilsbry in Tryon's Man. Conch., XI, p. 355, pl. 17, fig. 25.

The shell is small, high-conical, imperforate; whorls about six, almost flat with very little convexity, separated by subcanaliculated sutures, smooth with usually two, rarely three, impressed spiral lines near the lower suture which may be indistinct, or even wholly obsolete. Periphery angulated. Base convex with several spiral striæ. Aperture subquadrate. Height 8 millim., diameter 6 millim.

Living specimens of this species shine with a yellowish to greenish hue on the surface and iridescent green inside the aperture. The traces of the external colour are partly preserved in our fossils.

Not frequent.

Fossil occurrence.—Miyata Zone (Mukaibatake in Shimo-Miyata); Yokosuka Zone (Yokosuka and Otsu).

Living.—Central and Western Japan.

Genus ***Bembix***, Watson.

99. **Bembix crumpii**, (Pilsbry).

Pl. V. Figs. 27, 28.

Bathybembix crumpii. Pilsbry, Nautilus VI, p. 105, 103, pl. II, fig. 3. Cat. Mar. Moll. Japan, p. 97, pl. XI, fig. 4.

Only fragments, but recognized by a thin shell with two coarse spiral rows of distant spined tubercles with another row of much smaller tubercles close to the upper suture. The base has either distant crenulated spiral cords or rows of tubercles linked by threads. The specimens are somewhat smaller than that figured by Pilsbry. Rather frequent.

Fossil occurrence.—Kamakura Zone (Kewaizaka in Kamakura); Kanazawa Zone (Kanazawa and Teramae); Koshiba Zone (Koshiba).

Living.—Japan (Shelly O. Crump).

100. **Bembix convexiusculum**, Yokoyama.

Pl. V. Fig. 32.

Shell thin, turbinate, imperforate. Whorls about eight, rather convex, with a spiral row of granules close to the lower as well as to the upper suture and with the intermediate space smooth. Periphery which is formed by the lower row of granules angulated. Base convex with about five distant subnodose spiral threads. Aperture subquadrate or subrhombic with the diagonal from front to behind longer than the other. The best, though not the largest, specimen measures 28 millim. in height and 19 millim. in diameter. Rare.

This species is easily distinguished from the foregoing by the want of large spiny tubercles. Rare.

Fossil occurrence.—Kamakura Zone (Kewaizaka in Kamakura); Kanazawa Zone (Kanazawa).

Genus *Margarita*, Leach.

101. Margarita umbilicalis, Broderip et Sowerby.

Pl. V. Fig. 29.

Margarita umbilicalis. Broderip and Sowerby, Mal. and Conch. Mag., I, p. 26, 1836. Conch. Illust., fig. 5. Pilsbry, in Tryon's Man. Conch., XI, p. 288, pl. 39, figs. 61, 62, 64, pl. 64, figs. 39–41.

Trochus umbilicalis. Philippi in Syst. Conch. Cab. Mart. u. Chem., vol. II, part 3, Trochus, p. 245, pl. 37, fig. 2.

Two badly preserved specimens, the one with the diameter of about 9 millim. and the other with that of 8 millim. The shell is widely umbilicate, depressed-conic, thin, composed of about six convex whorls whose upper ones are closely spirally striated, the striæ becoming obsolete on the lower whorls. Sutures deeply impressed. Aperture oblique, subcircular. Peristome simple. Umbilicus deep, funnel-shaped.

Though the greater part of the shell is broken, there is no doubt of its being the well-known arctic species.

Fossil occurrence.—Kamakura Zone (Kewaizaka in Kamakura).

Living.—Polar seas (Greenland, Melville Island, etc.).

102. Margarita cinerea, Couthony.

Pl. V. Fig. 30.

Margarita cinerea. Pilsbry in Tryon's Man. Conch., XI, p. 291, pl. 44, figs. 20, 25, pl. 60, fig. 29. Gould, Invertebr. Massach., p. 252. Loven, Index Moll. Scandin. p. 20.

Trochus cinereus. Philippi in Syst. Conch. Cab. Mart. u. Chem., vol. II, part 3, p. 252, pl. 37, fig. 15.

Turbo cinereus. Couthony, Bost. Journ. Nat. Hist., II, p. 99, pl. 3, fig. 9.

A single example.

The shell is small, only 4 millim. in height and about 3,8 millim. in diameter, thin, turbinate, umbilicate. The whorls are about six, shouldered, weakly convex on side, and flattened and horizontal above, spirally lirate, and obliquely striate. The liræ, except on the body-whorl, are four in number, subequal, the uppermost being on the flattened upper surface close to the suture, the next one forming the angular shoulder and the two remaining ones being on the lateral surface, dividing it into three subequal

parts. On the body-whorl there is a fifth lira at the periphery which is subangular. The oblique striæ are sharp, numerous, narrower than interspaces, crossing the spiral liræ with points of intersection nodose. Base flatly convex, with two spiral liræ close to the periphery and some indistinct ones in the middle portion crossed by lines of growth. Umbilicus wide, funnel-like, bordered by two rows of granulated threads, the outer one of which forms the angular margin, with lines of growth within the umbilicus rather coarse. Aperture subcircular, very slightly subangular below.

I believe, this is one of the many forms of *Margarita cinerea* which is said to be very variable. The Japanese fossil looks very much like fig. 54 (pl. 64) of Pilsbry.

Fossil occurrence.—Miyata Zone (Kami-Miyata).

Living.—Behring Sea, North Atlantic (Massachusetts; Hebrides and Norway and still northward).

Genus ***Turcica***, A. Adams.

103. **Turcica imperialis**, A. Adams.

Pl. V. Fig. 31.

Turcica imperialis. A. Adams, Proc. Zool. Soc. Lond., 1863, p. 507. Pilsbry in Tryon's Man. Conch., XI, p. 414, pl. 63, figs. 30, 31.

Trochus imperialis. Lischke, Jap. Meeresconch., III, p. 67, pl. IV, figs. 5, 6. Tokunaga, Foss. Env. Tokyo, p. 28, pl. I, fig. 60.

Trochus adamsianus. Schrenck, Moll. Amurl. u. d. nordjap. Meeres, p. 358, pl. XVI, fig. 3.

A fine specimen, 19 millim. in height and 16 millim. in diameter. Adams described this species as follows:—

"Shell conoidal, spire acuminate, base obliquely produced, solid; whorls somewhat convex, with a strong nodulous cingulus at periphery, and beaded lirulæ alternating with elevated lines, interstices obliquely striate; sutures canaliculate; furnished with a series of granules above; base convex, furnished with concentric granulose cinguli. Aperture oblique, subcircular; columella tortuous; terminating in a tooth; lip subexpanded, with entire margin; inside smooth."

In our specimen, the granulose cinguli of the base are alternately coarse and fine, and about twelve in all. The aperture is subquadrate.

Fossil occurrence.—Miyata Zone (Mukaibatake in Shimo-Miyata). Upper Musashino of Kazusa and Musashi.

Living.—Northern, Central and Western Japan.

Genus ***Calliostoma***, Swainson.

104. **Calliostoma cipangoanum**, Yokoyama.

Pl. V. Fig. 23.

Shell small, conical, imperforate; whorls about five, slightly convex, spirally ribbed; ribs three with somewhat broader interspaces, the uppermost one close to the suture and beaded; on the body-whorl there is a fourth rib which is smooth and forms the keeled periphery; a fine interstitial line is present in each interspace except the lowest. Base rather flat with many close unequal spiral threads. Incremental lines indistinct except on the base. Aperture trapezoidal. Columella smooth. Height 3,5 millim., diameter 3,5 millim.

A single example. It resembles *Calliostoma occidentalis* Mighels et Adams (Pilsbry in Tryon's Man. Conch. XI, p. 393, pl. 37, figs. 2, 3) from North Atlantic and the English Crag, but the periphery is decidedly more angular.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

105. **Calliostoma sagamianum**, Yokoyama.

Pl. VI. Fig. 1.

Shell conical, imperforate, rather solid; whorls nearly flat with two elevated, granose spiral ridges dividing the surface into three unequal parts, of which the middle is the broadest and the lower the narrowest; these interspaces are ornamented with several unequal beaded striæ whose number varies between two and six according to the breadth of the interspace. Periphery carinated, smooth. Base flattened, with many close unequal smooth spiral striæ. Aperture trapezoidal.

The only specimen we possess lacks the upper portion of the spire, but it seems to have been high-conical. The diameter is 9 millim.

Fossil occurrence.—Naganuma Zone (Naganuma).

Genus ***Euchelus***, Philippi.

106. **Euchelus fenestratus**, Yokoyama.

Pl. VI. Fig. 2.

Shell small, thick, globose-conical, imperforate; whorls about five, quickly growing, convex, spirally ribbed and longitudinally costellated; spiral ribs three on the penultimate whorl, eight on the last, with about equal interspaces, crossed by costellæ, dividing the interspaces into square pits, and making the ribs granose. Sutures impressed. Periphery rounded. Base convex, with an interstitial riblet between some ribs and developed only behind the outer lip. Columella smooth. Aperture subcircular. Outer lip thick, denticulate within, about 12 teeth being present between the posterior angle of the aperture and the lower end of the columella. Height and diameter 5 millim.

This shell of which we possess only one specimen resembles *Euchelus ruber* A. Adams (Tryon's Man. Conch. XI, p. 440, pl. 67, fig. 79) living near Kamakura and in the Japan Sea, which is however umbilicate and has a greater number of spiral ribs.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

Genus ***Umbonium***, Link.

107. **Umbonium giganteum**, (Lesson).

Pl. VI. Fig. 5.

Umbonium giganteum. Pilsbry in Tryon's Man. Conch., XI, p. 454, pl. 58, figs. 17-18. Dunker, Index Moll. Mar. Jap., p. 134.

Rotella gigantea. Lesson, Illust. de Zool., t. 17, 1831. Kiener, Spec. et Icon. Coq. Viv., p. 46, pl. 3, fig. 7. Sowerby, Thes. Conch., V, p. 136, pl. 472 figs. 15, 16.

Globulus giganteus. Lischke, Jap. Meeresconch., vol. III p. 63.

A fractured specimen of a large, solid, depressed *Umbonium* with flattened to somewhat concave smooth whorls, rounded

periphery and slightly convex smooth base, is evidently a species now living near the coast of Central and Western Japan.

Fossil occurrence.—Naganuma.

Living.—Central and Western Japan.

108. **Umbonium costatum,** (Valenciennes).

Pl. VI. Fig. 6.

Umbonium costatum. Pilsbry in Tryon's Man. Conch., XI, p. 454, pl. 59, figs. 34, 35. Dunker, Index Moll., p. 134.

Rotella costata. Valenciennes in Kiener, Spec. et Icon. Coq. Viv., p. 10, pt. 2, fig. 2.

Globulus costatus. Lischke, Jap. Meeresconch., I, p. 91. Schrenck, Moll. d. Amurl. u. d. nordjap. Meeres, p. 367.

A large specimen measuring about 25 millim. in diameter and a much smaller one.

This species is like the preceding in shape, but easily distinguished by spiral grooves running over the whorls and a tendency to tuberculation of the uppermost part of the same. The original colour is faintly preserved.

Fossil occurrence.—Naganuma Zone (Naganuma). Upper Musashino of Shimosa and Kazusa.

Living.—Northern, Central and Western Japan.

Family **Cyclostrematidæ.**

Genus ***Cyclostrema,*** Marryatt.

109. **Cyclostrema duplicatum,** Lischke.

Pl. VI. Fig. 8.

Cyclostrema duplicatum. Lischke, Malakozool. Blätter, vol. 19, p. 101. Jap. Meeresconch., vol. III, p. 61, pl. III, figs. 9, 10.

A single example 4 millim. in diameter agrees fairly well with a species described by Lischke under the above name. It is characterized by the double-keeled periphery above which there are two more keels. The base was described by Lischke as having two keels and the elevation surrounding the umbilicus is said to be keel-like. But in our specimen the base shows only a single keel and instead of a keel-like elevation there is only a rounded swell. The round and thickened mouth and spiral striæ

on whorls and base crossed by lines of growth agree with the Lischke's description.

Fossil occurrence.—Yokosuka Zone (Yokosuka).

Living.—Central Japan.

Family **Fissurellidæ.**

Genus ***Macroschisma***, Swainson.

110. **Macroschisma sinensis**, A. Adams.

Pl. VI. Fig. 3.

Macroschisma sinensis. A. Adams, Proc. Zool. Soc. Lond., 1855, p. 122. Sowerby, Thes. Conch., vol. III, p. 250, fig. 219. Pilsbry in Tryon's Man. Conch., vol. XII, p. 190, pl. 59, figs. 56–59. Catal. Mar. Moll. Japan, p. 107, pl. VI, figs. 6–8.

This oblong shell with subparallel lateral margins, a fine latticed sculpture and a long narrow perforation posteriorly somewhat widened and equal to about one-third the length of the shell, has been minutely described by Pilsbry both in the Manual of Conchology and his Catalogue.

We possess three examples, the largest of which measures 19 millim. in length, 8,5 millim. in breadth and 5 millim. in height.

Fossil occurrence.—Yokosuka Zone (Yokosuka and Otsu). Upper Musashino of Shimosa.

Living.—Central Japan, China Sea, Singapore.

Genus ***Fissuridea***, Swainson.

111. **Fissuridea cf. tanneri**, (Verrill).

Pl. VI. Fig. 18.

Fissurella tanneri. Verrill, Proc. U. S. Nat. Mus., vol. V, p. 333, 1882; Trans. Conn. Acad. Sci., VI, p. 255, pl. 29, fig. 13.

Glyphis tanneri. Pilsbry in Tryon's Man. Conch., XII, p. 213, pl. 63, figs. 25, 26.

Verrill's description of *Fissurella tanneri* runs as follows:

"Shell large, ovate, rather thin, with regularly and finely decussated sculpture. Apex nearer the anterior (smaller) end, moderately elevated. Perforation not large, round-ovate, conformable with the outline of the shell but more rounded, whole surface covered with rather fine, raised, radiating lines, with interstices of similar width or narrower; these are decussated by

numerous concentric raised lines, which rise into nodules, or towards the margin form small arched lamellæ in crossing the radii."

We possess two imperfect specimens, one of which measures about 10 millim. in height and is shown in the figure. They agree quite well with the above description, except in the presence of "nodules" and "small arched lamellæ" towards the margin, but it must be remembered that our specimens are much worn by friction with coarse sands abounding in the layer in which they were imbedded.

Fossil occurrence.—Koshiba Zone (Koshiba).

The living specimens of *Fissuridea tanneri* are found on the east coast of North America, between Delaware Bay and Cape Hatteras in depths of 104–142 fathoms.

Genus ***Puncturella***, Lowe.

112. Puncturella subconica,* Yokoyama.

Pl. VI. Fig. 7.

The shell is elevated-conical, oblong in outline with acuminate involute vertex. The radiating riblets are alternately large and small, number about thirty-six in all, and are crossed by coarse unequal concentric lines of growth, making them appear subnodose in well preserved specimens. The summit is nearly in the middle pierced by a lanceolate fissure. Aperture oblong with subcrenulate margin. Height 5 millim., diameters 6 millim. by 4 millim. Three specimens.

In shape this species is just like *Puncturella fastigiata* (Proc. Zool. Soc., 1851, p. 228 and Thes. Conch., III, p. 208, figs. 15, 16) described by A. Adams from the Eastern Seas in which, however, the riblets are said to be equal. *Puncturella conica* Orb. from Falkland Islands (Thes. Conch. III, p. 208, pl. 245, figs. 1, 2) is very close to ours, the riblets being just as in the latter. But the figure given in Thesaurus looks a little flatter. Strange

* Puncturella conica Orb. in the list of shells given on p. 4 of my "Climatic Changes in Japan since the Pliocene Epoch" refers to this species.

to say, this same species is figured in Tryon's Manual (vol. XII, pl. 63, figs. 40, 41) much higher, with a larger summit and a more oval aperture, so that it looks like a different species. Therefore, in absence of real specimens for comparison, it is impossible to determine whether our fossil is identical with it or not. On this account I deemed it more advisable to describe the former as a new species. But the close relationship existing between the two is undeniable.

Fossil occurrence.—Koshiba Zone (Koshiba).

Genus ***Emarginula***, Lamarck.

113. **Emarginula fragilis**, Yokoyama.

Pl. VI. Fig. 10.

Shell thin, depressed-conic, ovately oblong in outline; apex subposterior, prominent, recurved with front slope convex and posterior slope nearly straight and steep. The sculpture consists of radiating riblets and concentric striæ. Radiating riblets numerous, about thirty in number with an interstitial riblet between, which generally does not attain the apex; between the riblet and the interstitial one there are still one to three equal or unequal fine striæ. Concentric striæ very fine, tolerably close together, especially distinct in the interspaces but going over the riblets, making them more or less granulate and rough. Posterior slit deep. Cicatrix elevated, bounded by two sharp ridges and divided into rectangular pits by transverse septa. Apertural margin crenulate. Height 8,5 millim., longer diameter 14 millim., shorter diameter 10 millim.

A single specimen.

This species comes closest to *Emarginula cancellata* Phil. (Thes. Conch., III, pl. 246, figs. 15, 16) of the Atlantic, but is more elevated and the posterior slope steeper.

Fossil occurrence.—Miyata Zone (Harashita in Shimo-Miyata).

114. **Emarginula** sp.

Pl. VI. Fig. 15.

Two imperfect specimens of a depressed-conical shell, more depressed but larger than the preceding species. The general outline is ovate-oblong or elliptical, with somewhat posterior recurved apex, and sculptured with alternately large and small radiating riblets between which there may be still one or two finer ones. The total number of large and small riblets may be about sixty. There riblets are also crossed by very fine somewhat distant concentric lines most distinct in the intercostellar spaces. The anterior portion of the shell is broken in both specimens, therefore the form of the slit and cicatrix are not known. One of the specimens measures 6 millim. in height about 16 millim. in length and 12 millim. in width. It seems to resemble *Emarginula costulata* Desh. (Tryon's Manual, XII, pl. 41, figs. 12, 13) and *Emarginula puncticulata* A. Ad. (Thesaur., III., Emarginula fig. 14), but a strict comparison is not possible.

Fossil occurrence.—Koshiba Zone (Koshiba).

Family **Acmæidæ.**

Genus ***Acmæa***, Eschscholtz.

115. **Acmæa heroldi,** (Dunker).

Pl. VI. Fig. 12.

Acmæa heroldi. Pilsbry, Cat. Mar. Moll. Japan., p. 111, pl. VI, figs. 13–18. Lischke, Jap. Meeresconch., II, p. 96.

Patella heroldi. Dunker, Moll. Jap., p. 24, pl. III, fig. 13.

Patella pygmæa. Dunker, Moll. Jap., p. 24, pl. III, fig. 20.

Tectura heroldi. Dunker, Index Moll., p. 154.

A small ovately elliptical shell, not very high, sculptured with unequal riblets which are either close together, or more or less separate. Vertex situated at the anterior fourth of the shell's length. The largest of our specimens measures 5 millim. in height, about 12,5 millim. in length and 9 millim. in width. Rare.

Fossil occurrence.—Yokosuka Zone (Otsu and Yokosuka).
Living.—Central and Western Japan.

116. **Acmæa kuragiensis,** Yokoyama.

Pl. VI. Fig. 9.

Shell small, thin, conical, oval in outline, obtusely pointed at apex which is somewhat anterior. Anterior as well as posterior slope straight. The sculpture consists of very fine radiating lines crossed by equally fine but distinct concentric striæ, making them appear finely crenulate. Length 7 millim., breadth 5 millim., height 4 millim. A single specimen.

This shell is closely allied to *Acmæa triangularis* (Carp.) (Tryon's Manual, XIII, p. 20, pl. 7, figs. 74–78) and to *Acmæa patina* Esch. var. *ochracea* Dall (Tryon's Man., loc. cit., pl. 9, fig. 7–9), both from California. But our shell is distinguished from them by crenulate radiating lines.

Fossil occurrence.—Koshiba Zone (Koshiba).

117. **Acmæa nojimensis,** Yokoyama.

Pl. VI. Fig. 11.

Shell small, thin, conical, oblong in outline, with anterior and posterior slopes somewhat convex and lateral surfaces somewhat flattened. Apex a little anterior, pointed. Surface with fine radiating lines which are almost obsolete. Length 9 millim., breadth 5 millim., height 5 millim. A single specimen.

At first I took this for the same species as the preceding, but the higher form and the non-crenulate, obsolete radiating lines make it appear somewhat different. So at present I prefer to treat it as a new species. It is not unlike *Acmæa conulus* Dkr. (Moll. Jap., p. 24, pl. III, fig. 19) which is, however, higher and broader.

Fossil occurrence.—Kanazawa Zone (Nojima).

Family **Patellidæ.**

Genus ***Helcioniscus***, Dall.

118. **Helcioniscus pallidus,** (Gould).

Pl. VI. Figs. 16, 17.

Helcioniscus pallidus. Pilsbry in Tryon's Man. Conch., vol. XIII, p. 133, pl. 67, figs. 9, 10. Catal. Mar. Moll. Japan, p. 112.

Patella pallida. Gould, Proc. Bost. Soc. Nat. Hist., VII, p. 162. Dunker, Index Moll. Mar. Jap., p. 156. Lischke, Jap. Meeresconch., I, p. 112.

Patella lamanonii. Schrenck, Moll. d. Amurl. u. d. nordjap. Meeres, p. 303, pl. XIV, figs. 6-9.

There are several specimens which can be assigned to this species. The largest which is a little broken is 28 millim. long, about 24 millim. broad and 17 millim. high, with about twenty-two ribs at unequal distances and one to several interstitial riblets. The position of the apex varies as in the living forms, being either subcentral or more anterior. The shape is subovate to oval in outline and high-conical, the slopes being straight or somewhat convex.

Fossil occurrence.—Miyata Zone (Kami-Miyata, Shimo-Miyata and Motowada); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living.—Central and Northern Japan.

Class **Scaphopoda.**

Family **Dentaliidæ.**

Genus ***Dentalium***, Linne.

119. **Dentalium complexum,** Dall.

Pl. VI. Fig. 27.

Dentalium complexum. Dall, Proc. U. S. Nat. Mus., XVII, 1895, p. 686, pl. 26, fig. 3. Pilsbry in Tryon's Man. Conch., vol. XVII, p. 76, pl. 20, fig. 35. Iwakawa, Cat. Jap. Moll. Nat. Hist. Departm., Tokyo Imp. Museum, part I, p. 135.

Shell thick, solid, only gently curved towards the apex, with about forty round-topped, elevated longitudinal riblets which are

mostly subequal on the apertural end, but alternately large and small towards the apex. Interspaces generally wider than the riblets. Striæ of growth close, fine and sometimes very prominent. Orifices nearly circular.

This species is very much like *D. vernedei* Hanley (Sowerby, Thesaurus, vol. III, *Dentalium*, p. 101, pl. 225, fig. 3) living in our seas, but is readily distinguished by the interspaces being wider than the riblets, while the reverse is the case in the Hanley species.

Very frequent, especially in the Kanazawa and Koshiba Zones.

Fossil occurrence.—Kamakura Zone (Urago); Kanazawa Zone (Kanazawa and Nojima); Koshiba Zone (Koshiba); Naganuma Zone (Kikkōzan, Iijima and Naganuma).

Living.—Sandwich Islands at a depth of about 300 fathoms; also Enoura in Suruga Bay, Central Japan.

120. **Dentalium weinkauffi**, Dunker.

Pl. VI. Figs. 19–21.

Dentalium weinkauffi. Dunker, Index Moll. Mar. Jap., p. 153, pl. V, fig. 1. Pilsbry in Tryon's Man. Conch., vol. XVII, p. 40, pl. II, fig. 26.

Dentalium cf. weinkauffi. Tokunaga, Foss. Env. Tokyo, p. 33, pl. II, fig. 16.

This species is recognized by its well-curved shell, ribbed in the apical portion, but smooth in its apertural portion, the ribs gradually vanishing towards the latter. The number of ribs varies according to the individuals, but are generally between twelve and sixteen near the apical end, gradually increasing, however, towards the aperture. Frequent, but mostly broken.

Fossil occurrence.—Miyata Zone (Mukaibatake in Shimo-Miyata, and Kami-Miyata); Kanazawa Zone (Nojima); Koshiba Zone (Koshiba); Naganuma Zone (Naganuma); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Central Japan.

121. **Dentalium octogonum**, Lamarck.

Pl. VI. Figs. 22, 23, 24.

Dentalium octogonum. Lamarck, Anim. sans Vert., V, p. 344. Lischke, Jap. Meeresconch., II, p. 103, III, p. 75, pl. V, figs. 1-3. Dunker, Moll. Mar. Jap., p. 153. Schrenck, Moll. Amurl. u. d. Nordjap. Meeres, p. 381. Brauns, Geol. Envir. Tokio, p. 95. Tokunaga, Foss. Env. Tokyo, p. 33, pl. II, fig. 15.

Dentalium octangulatum. Donovan, Nat. Hist. Brit., Shells, V, pl. 162. Pilsbry in Tryon's Man. Conch., XVII, p. 16, pl. II, figs. 16-18, 22.

Dentalium hexagonum. Gould, Proc. Bost. Soc. Nat. Hist., vol. VII, p. 166. Otia Conch., p. 119. Sowerby, Thes. Conch., III, p. 103, pl. 223, fig. 10. Lischke, Jap. Meeresconch., III, p. 74, pl. V, figs. 4, 5, and var., figs. 6, 7. Pilsbry in Tryon's Man. Conch., XVII, p. 18, pl. II, figs. 20, 21, and var. 23, 24, 27, 28.

Dentalium sexcostatum. Sowerby, Thes., III, p. 103, pl. 223, fig. 11.

The shells of a *Dentalium* here figured have been formerly described as two distinct species under the names of *octogonum* and *hexagonum*. But the number of ribs on which the above distinction is based is very variable; it varies between six and nine. Fig. 22 has six, but fig. 23 has seven and fig. 24 nine. The interstitial riblets or striæ are also variable in number. In some interspaces there are none, in others there are three to six. They are equal or subequal, equidistant or inequidistant.

Frequent.

Fossil occurrence.—Miyata Zone (Nagai); Yokosuka Zone (Yokosuka and Otsu); Naganuma Zone (Naganuma); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern, Central and Western Japan; China; Australia; Ceylon.

122. **Dentalium edoense**, Tokunaga.

Pl. VI. Fig. 28.

Dentalium edoense. Tokunaga, Foss. Envir. Tokyo, p. 34, pl. II, fig. 17.

Several fragments of a small, slender, tubular shell, hardly 1.5 millim. in the greatest diameter, well curved but with curvature not always quite regular, and with surface smooth, glossy, and more or less uneven in some parts seem to be identical with the one described by Tokunaga under the above name. In one specimen very faint and extremely fine longitudinal lines are observable under a strong magnifier.

Fossil occurrence.—Miyata Zone (Nagai); Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma); Upper Musashino of Musashi and Shimosa.

Living.—Central and Western Japan.

Genus ***Cadulus***. Philippi.

123. **Cadulus gordonis**, Yokoyama.

Pl. VI. Fig. 25, 26.

Shell small, slender, slightly curved, smooth, obtusely angulated just behind the aperture, whence it narrows both anteriorly and posteriorly, but very quickly anteriorly and very gradually posteriorly. Aperture circular, straight. No slit. Length 7 millim. greatest diameter 1 millim., posterior diameter 0,8 millim. Two specimens, one of which is broken.

This species is closely allied to *Cadulus acus* Dall (Tryon's Manual, XVII, p. 191, pl. 36, fig. 27) from the West Indies in which, however, the shell is more pointed and the aperture somewhat oblique.

Fossil occurrence.—Miyata Zone (Nagai); Naganuma Zone (Naganuma).

Class **Lamellibranchiata.**

Order **Teleodesmacea.**

Family **Pholadidæ.**

Genus ***Pholas***, Linné.

124. **Pholas fragilis**, Sowerby.

Pl. VI. Fig. 29.

Pholas fragilis. Sowerby, Thes. Conch., vol. II, p. 488, pl. 108, figs. 92, 93. Lischke, Jap. Meeresconch., I, p. 143.

Barnea fragilis. Dunker, Index Moll., p. 170.

The shell is thin, fragile, transversely elongated, with the anterior ventral margin widely notched and gaping, and the posterior margin roundly pointed. The sculpture consists of

numerous, low, wavy, concentric laminæ, more wavy in the anterior than in the posterior half; and these waves are so arranged as to cause their crests to form radiating ribs which become fainter towards the posterior, getting quite obsolete near the posterior end of the surface. In some specimens the laminæ in the posterior part are cut up into many small parts or tubercles which are again arranged in a radial direction.

In none of the several specimens at hand is the dorsal shield preserved. The largest one measures 30 millim. in length and 11 millim. in height.

Fossil occurrence.—Yokosuka Zone (Otsu and Yokosuka). Upper Musashino of Shimosa.

Living.—Western Japan; Philippines.

Genus ***Jouannetia***, C. des Moulins.

125. **Jouannetia japonica**, Yokoyama.

Pl. VII. Fig. 1.

Shell small, thin, fragile, globose, widely gaping in front, with the anterior end bluntly pointed and smooth, and the posterior end rounded. Surface divided into two parts by a deep groove running from beak to antero-ventral angle, whence the margin which is crenate ascends obliquely upward anteriorly. The sculpture consists of distant concentric laminæ which in the anterior portion are wavy, the crests of the waves forming about eight radiating ribs whose interspaces are unequal, being broader in the anterior portion. Accessory plates not preserved. Height 6 millim., length about 7 millim. Rare.

Quoy and Gaimard described an allied species from the Philippines under the name of *Pholas globulosa* (Voy. Astrolabe, III, p. 549, pl. 83, figs. 16–19) in which, however, the anterior end is serrate, and there is a radiating row of angular points in the middle of the posterior half of the surface.

Another allied species is living in the Bay of Sagami. It is still undescribed, but is very close to the fossil form, the chief

distinction lying in the finer radiating ribs and closer, less prominent, concentric laminæ.

Fossil occurrence.—Yokosuka Zone (Otsu).

Family **Saxicavidæ.**

Genus ***Saxicava***, Fleuriau de Bellevue.

126. **Saxicava orientalis**, Yokoyama.

Pl. VII. Figs. 2, 3.

Shell thin, fragile, transversely elongato-oblong, moderately convex, inequilateral, the anterior side being about one-third of the posterior, rounded in front, subtruncate (?) behind, nearly straight ventrally. Surface rather uneven, with an edge running from beak to postero-ventral angle which is rather sharp near the beak, but blunt and indistinct near the shell-margin. The sculpture consists of coarse irregular lines of growth, most prominent behind the umbonal edge. Pallial line indistinct, but pearly lustre is visible along it. Tooth one in each valve, triangular and transversely elongated, situated just below the beak and close to it.

A few specimens which we possess are all more or less fractured. The left valve shown in the figure measures 11 millim. in length, 7 millim. in height and 1,5 millim. in depth.

A shell described as *Saxicava? fragilis* Nyst. by Wood from the Coralline Crag (vol. II, Bivalves p. 288, pl. XXIX, 6) is somewhat like our species, though decidedly shorter.

Fossil occurrence.—Yokosuka Zone (Otsu). Upper Musashino of Kazusa.

Family **Pholadomyidæ.**

Genus ***Pholadomya***, Sowerby.

127. **Pholadomya japonica**, Yokoyama.

Pl. VI. Figs. 30, 31.

Two good specimens were obtained, but owing to the extremely fragile state of the shell, they became subsequently very imperfect.

The shell is transversely elongate and oblong, very inequilateral, swollen, and more so in the anterior than in the posterior portion. The sculpture consists of concentric ribs and radiating rows of tubercles. The concentric ribs are low and roof-like, with wide flat intervals, getting posteriorly unequal and irregular, and looking like coarse incremental lines. The radiating ribs which are not present in the posterior portion of the shell are distant and made up of rows of sharp tubercles on the concentric ribs, which get sharper and spiny in the anterior portion. These ribs situated in the middle portion of the shell leave tubercular impressions on the cast, while those situated in its anterior portion leave none. The impressions of concentric ribs on the internal cast are more prominent than the real ribs on the shell's surface.

This species is like *Pholadomya hesterna* Sow. (Wood, Crag Moll., Bivalves, p. 166, pl. XXX, fig. 1) of the English Crag which is, however, more swollen and spiny.

Fossil occurrence.—Naganuma Zone (Naganuma).

Family **Corbulidæ**.

Genus ***Corbula***, Bruguière.

128. **Corbula venusta**, Gould.

Pl. VII. Figs. 4–6.

Corbula venusta. Gould, Proc. Bost. Soc. Nat. Hist., vol. VIII, p. 25. Otia Conch., p. 164. Schrenck, Moll. d. Amurl. u. d. Nordjapan. Meeres, p. 583, pl. XXV, figs. 1–4. Dunker, Index Moll., p. 177. Tokunaga, Foss. Env. Tokyo, p. 39, pl. II, fig. 22.

A small, solid, ovately triangular, rather compressed shell is broader than high, rounded in front and obliquely subtruncate behind, with the ventral border broadly arcuate. The surface is marked by a sharp edge running from the beaks to the postero-ventral angle, and there is a shallow depression running longitudinally in the middle portion, distinct near the beaks, but indistinct toward the ventral margin. The sculpture consists of concentric grooves which are rather irregular and unequal. Length 10 millim., height 7 millim., thickness 4.5 millim.

Very frequent.

Fossil occurrence.—Miyata zone (Shimo-Miyata, Yamagayado in Kami-Miyata, Motowada and Nagai); Yokosuka Zone (Otsu and Yokoska); Koshiba Zone (Koshiba); Naganuma Zone (Naganuma); upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern Japan (the Hokkaido).*

Genus ***Basterotia***, Mayer.

129. **Basterotia gouldii** (A. Adams).

Pl. VII. Fig. 7.

Basterotia gouldi. Pilsbry, Cat Mar. Moll. Japan, p. 118.

Eucharis gouldii. A. Adams, Ann. Mag. Nat. Hist., April, 1864, p. 309, November 1868, p. 366. Dunker, Index Moll. Mar. Jap., p. 178, pl. IX. figs. 7-11.

Shell ovately subtrigonal, convex, rugosely concentrically striate, subgranose in front. Beaks tumid, strongly inclined forward, with an obtuse keel running from the beak to the postero-ventral angle. Right valve with one strong tooth and a ligamental pit behind it.

A single right valve 8.5 millim. long and 7,5 millim. high.

Fossil occurrence.—Yokosuka Zone (Otsu).

Living.—Western Japan (Setouchi, Kyushu).

130. **Basterotia trapezium,** Yokoyama.

Pl. VII. Figs. 8, 9.

Shell rather thin, moderately swollen, strongly inequilateral, roundly four-sided, no two sides of which are equal or parallel, narrowed towards front and rounded at margin, dilated behind and obliquely truncate, so that the posterior margin forms a rounded angle with the broadly arcuate ventral margin. Surface concentricatly rugose, a keel which may be rather indistinct running from the beak to the postero-ventral angle. Beaks small, pointed.

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* Tokunaga mentions Whampoa near Canton as one of the places where *Corbula venusta* lives. But this seems to be a mistake.

Two right valves one of which is 11 millim. long, 8 millim. high and 3 millim. deep, while the other is 9,5 millim. long, 6,5 millim. high and 2,5 millim. deep.

This species is closely allied to a living one found in Sagami Bay and probably identical with *Basterotia recluzei* A. Adams (Ann. Mag. Nat. Hist., 1864, p. 309, unfigured). But the living form is less inequilateral and the difference of the heights of the anterior and posterior ends less great.

Fossil occurrence.—Yokosuka Zone (Otsu).

Family **Mesodesmatidæ.**

Genus ***Ervilia***, Turton.

131. **Ervilia otsuensis**, Yokoyama.

Pl. VII. Figs. 21, 22.

Shell small, rather strong, moderately convex, ovately triangular, equilateral; anterior border rounded, posterior obliquely subtruncate, making a sharp angle with the broadly arcuate ventral border. Surface concentrically and rather unequally grooved. Beaks median, small but pointed. Anterior as well as posterior cardinal tooth strong, with a longly triangular ligamental pit between, whose posterior basal angle somewhat projects obliquely downward. Pallial line distinct with sinus shallow, rapidly narrowing and bluntly ending. One left and one right valve apparently belonging to different individuals.

The left valve measures 15 millim. in length, 12 millim. in height and 3,5 millim. in depth. The right valve is slightly larger.

Fossil occurrence.—Yokosuka Zone (Ōtsu).

Family **Mactridæ.**

Genus ***Mactra***, Linné.

132. **Mactra veneriformis**, Deshayes.

Pl. VII. Fig. 10.

Mactra veneriformis. Deshayes, Proc. Zool. Soc. London, 1853, p. 15. Reeve, Conch. Icon., Mactra, pl, IX, fig. 78. Lischke, Jap, Meeresconch., I, p. 133, II, p. 121, pl. IX, fig, 7,8. Wein

kauff in Syst. Conch. Cab. v. Mart. u. Chemn. XI, pt. 2, Mactra, p. 63, pl. 22. fig. 3,3a. Brauns, Geol. Envir. Tokio, p. 38, pl, IV, fig. 17. Tokunaga, Foss. Envir. Tokyo, p. 40.

Mactra quadrangularis. Deshayes, Proc. Zool. Soc. London, 1853, p. 15, No. 5. Reeve, loc. cit., pl. 1, fig. 3.

Trigonella veneriformis. Dunker, Index Moll., p. 182.

We possess two specimens of the left valve which are both ventricose, though somewhat differeing in shape. The one is roundly triangular, while the other is more quadrangular. The former has both ends of the shell more pointed than the latter and corresponds to what Lischke at first called *Mactra zonata* (loc. cit. II. p. 6) and subsequently reduced to a variety of *Mactra veneriformis* (II. p. 121). Indeed, the form is very variable as shown by hundreds of specimens now living in Tokyo Bay.

Fossil occurrence:—Yokosuka zone (Otsu); Upper Musashino of Musashi and Shimosa

Living.—Central and Western Japan; Northern China.

Genus *Lutraria*. Lamarck.

133. Lutraria radiata, Yokoyama.

Pl. VII. Fig. 11.

Two right valves, the larger measuring 68 millim. in length, 33 millim. in height, and 7,5 millim in depth.

The shell is thin, compressed, transversely elliptical, posteriorly somewhat dilated, strongly inequilateral the anterior side being somewhat less than one-half its posterior side; anterior as well as posterior end rounded, ventral border broadly arcuate and sharp, dorsal border nearly straight. The surface sculpture consists of small wrinkles covering the concentric lines of growth, and faint radiating, more or less straight striae most distinct in the central and anterior portions, but obsolete in the posterior portion and in the region near the beak. Pallial sinus very large, linguiform. Ligamental pit triangular with a strong tooth in front of it, while the one behind it is very thin.

The inner side of the shell still possesses traces of a dark purplish colour, especially along the margins.

Fossil occurence.—Naganuma Zone (Naganuma),

Family **Solenidæ**.

Genus ***Solen***, Linné.

134. Solen gordonis, Yokoyama.

Pl. VII. Fig. 23.

Shell linear, straight, with upper and lower margins straight and parallel; anterior end truncate, nearly perpendicular and straight or even slightly concave with angles a little rounded; posterior end also truncate, straight, perpendicular, with angles somewhat more rounded than those of the anterior.

A single specimen present is 100 millim. long, and 19 millim high at the anterior and 20 millim. at the posterior end.

This species is very closely akin to *Solen beckii* Philippi (Abbild., III, p. 43, Solen pl. II. fig. 1) from an unknown locality, in which, however, the anterior end is more oblique and the posterior more rounded.

Living.—Western Japan (Awaji Island).

Fossil occurrence.—Miyata Zone (Shimo-Miyata).

Genus ***Solecurtus***, Blainville.

135. Solecurtus abbreviatus, Gould.

Pl. VII. Figs. 12, 13.

Solecurtus abbreviatus. Gould, Otia Conch., p. 164. Reeve, Conch. Icon., Solecurtus, pl. II, fig. 6. Clessin in Syst. Conch. Cab. Mart. u. Chem., vol. XI, pt. 3, Solenaceae. p. 93, pl. 22, fig. 3.

The shell is thin and rather compressed, transversely oblong, more than twice as long as high, anteriorly and posteriorly broadly rounded, the posterior end sometimes appearing obliquely subtruncate rather than rounded. The ventral border is somewhat excavated in the middle, while the dorsal border is nearly straight, the arching being very slight. The beak is nearly median, the anterior side being only very little longer than the posterior. The surface is concentrically wrinkled, with a distinct radiating groove

in the middle which is directed a little obliquely to the posterior side, and considerably widens towards the ventral margin. The inner surface of the shell shows a broad, somewhat elevated rib corresponding to the external groove and also many radiating lines, a few of which behind the rib are very marked and rib-like. Pallial sinus large, deep and rounded.

There are many specimens which, however, owing to the thin and brittle state of the shell are mostly broken. The largest and best preserved one is a left valve, 44,5 millim. in length, 20,5 millim. in height and about 7 millim. in depth.

A living shell which we possess for comparison is unfortunately waterworn and bleached, but the original colour seems to have been yellowish, and a part of the epidermis still attached to the shell is dark green in colour.

Fossil occurrence.—Naganuma Zone (Naganuma).

Living.—Central Japan (Coast of Awa or Bōshu); Hong-Kong.

136. **Solecurtus divaricatus,** (Lischke).

Pl. VII. Fig. 14.

Solecurtus divaricatus. Clessin in Syst. Conch. Cab. Mart. u. Chemn., vol. XI, pt. 3, Solenacea, p. 87, pl. 21, fig. 4.

Macha divaricata. Lischke, Jap. Meeresconch., I, p. 142, pl. X, figs. 1,2. Dunker, Index Moll., p. 175, pl. VII, fig. 26. Tokunaga, Foss. Env. Tokyo, p, 36, pl. II. fig. 20.

A single fragment of the posterior end of the right valve which, on comparison with the living specimens, leaves no doubt of its being the above mentioned species.

Fossil occurrence.—Yokosuka Zone (Otsu); Upper Musashino of Shimosa, Kazusa and Musashi.

Living.—Central and Western Japan.

Family **Tellinidæ.**

Genus ***Tellina,*** Linné.

137. **Tellina nitidula,** Dunker.

Pl. VII. Fig, 15.

Tellina nitidula. Dunker, Moll. Jap., p. 27., pl. III, fig. 14. Lischke, Jap. Meeresconch., I, p. 129, II, p. 113, pl. X, figs. 10, 11. Brauns, Geol. Env. Tokio, p. 39, Tokunaga, Foss. Envir. Tokyo, p. 42, pl. II, fig. 30. abc.

The shell is transversely oval, very thin, compressed, with the anterior side longer than the posterior. The anterior margin is rounded, while the posterior is arcuate and at its junction with the ventral margin bluntly angulate. The hinge consists of two small diverging teeth, of which the anterior in the left valve and the posterior in the right valve is bifid. The so-called Tellina-fold is not so marked in this species. The surface in grown specimens is concentrically striated. The umbonal edge running from the beak to the postero-ventral angle is very obtuse. The pallial sinus is large and deep, almost reaching to the anterior adductor impression.

One left valve and one small right valve. The former measures 23 millim. in length and 14 millim. in height.

Fossil occurrence.—Miyata Zone (Nagai) and Naganuma Zone (Naganuma); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Central and Western Japan.

138. **Tellina ojiensis**, Tokunaga.

Pl. VII. Figs. 16, 17.

Tellina ojiensis. Tokunaga, Foss. Env. Tokyo, p. 44, pl. II, figs, 34 a, a', b.

The shell is rather small, not very thin, compressed, obliquely subovate, somewhat inequivalve and inequilateral, the posterior side being a little shorter than the anterior. Anterior and posterior dorsal margins sloping, the posterior more steeply than the anterior. Anterior margin rounded and passing gradually into the broadly arcuate ventral margin. Postero-ventral angle obliquely truncate. The surface is covered with fine, regular, concentric grooves which, at the obtuse umbonal edge, abruptly curve upward. Posterior fold rather weak. Of the two cardinal teeth, the anterior in the left valve and the posterior in the right valve is bifid. Lateral teeth two, one on each side. Pallial sinus very large and deep, reaching nearly to the anterior adductor impresion. Rather frequent. The largest left valve in our possession measures 19 millim. in length of which 8,5 millim.

belong to the posterior side, 14 millim. in height, and 3,5 millim. in depth.

Fossil occurrence.—Miyata zone (Nagai and Kami-Miyata); Upper Musashino of Musashi and Shimosa.

Living.—Northern Japan according to Tokunaga.

139. **Tellina vestalioides,** Yokoyama.

Pl. VII, Fig. 25.

Two left valves.

Shell transversely oblong, compressed, thin, somewhat inequilateral, the posterior side shorter than the anterior, anterior border rounded, going over gradually on one side into the sloping dorsal margin and on the other into the broadly arcuate ventral margin, posterior border obliquely truncate, making obtuse angles with the gradually sloping dorsal margin as well as with the ascending ventral margin, the angle with the former being more obtuse than that formed with the latter. Surface uniformly and flatly convex, except the region bounded by a very obtuse umbonal edge and postero-dorsal margin which is somewhat depressed along the median line. The sculpture consists of concentric incremental lines and very faint and unequal radiating lines which are also seen on the inner surface. Cardinal teeth two, the anterior in the left valve being bifid. Laterals indistinct in the same valve. Posterior fold very slight. Pallial sinus very deep, reaching almost to the anterior muscular impression. Length 32 millim. of which 17,5 millim. belong to the anterior side, height 19,5 millim., depth 4 millim.

This species is very closely related to *Tellina vestalis* Hanley (Syst. Conch. Cab. Mart. Chemn., vol. X, pt. 4, Tellinidae, p. 174, pl. 35, figs. 9–11) from the Philippines, so closely, indeed, that there is almost no marked difference in shape. But the latter seems to differ from ours in the following points : very thin and translucent shell, a single tooth in the left valve instead of two, and absence of faint radiating lines.

Fossil occurrence.—Naganuma Zone (Naganuma).

Living.—Northern Japan (Hakodate).

140. **Tellina serricostata,** Tokunaga.

Pl. VII. Fig. 24.

Tellina serricostata. Tokunaga, Foss. Envir. Tokyo, p. 43, pl. 11, fig. 32.

Shell thin, flattened, transversely ovate, almost equilateral. Anterior margin rounded, posteriorly rostrate with end obliquely truncate; antero-dorsal margin sloping, somewhat convex; postero-dorsal margin also sloping, slightly concave; ventral margin broadly arcuate, becoming more straight towards the posterior end, or even, shallowly notched near it. Surface with a blunt edge, running from the beak to the postero-ventral corner. The space between the edge and the postero-dorsal margin is only slightly depressed. The sculpture consists of fine concentric lamellar riblets with the interspaces looking like furrows. Beaks small but prominent, directed posteriorly. Main teeth two, the anterior in the right valve consisting of two separate teeth; laterals in the right valve distinct, one on each side. Pallial sinus large and deep, reaching near to the anterior muscular impression and going upward to two-thirds the height of the shell.

Only two right valves, the larger of which is 26 millim. long, 15 millim. high and 35 millim. deep.

This species shows a close resemblance in shape to *Tellina incarnata* L. (Syst. Conch. Cab., vol. X, part 4, p. 126, pl. 29, figs. 1–5) of the Atlantic, but the lamellar riblets and the separate anterior main tooth of the right valve are the chief distinguishing characters.

Fossil occurrence.—Miyata Zone (Kami-Miyata); Naganuma Zone (Naganuma). Upper Musashino of Musashi.

141. **Tellina miyatensis,** Yokoyama.

Pl. VII. Fig. 18.

Shell small, thin, flattened, transversely suboblong, very inequilateral, the anterior side more than double the length of the posterior. Anterior end perpendicularly truncate, posterior rounded, gradually passing into the sloping antero-dorsal margin

as well as into the broadly arcuate ventral margin which in the posterior part becomes nearly straight and forms a rounded right angle with the truncate end. Postero-dorsal margin straight, sloping, but somewhat more steeply than the antero-dorsal. Surface with an obtuse edge or keel running from beak to postero-ventral corner, the narrow space bounded by this edge and the postero-dorsal margin being quite flat. The sculpture consists of fine concentric furrows which bend abruptly upward at the edge. Main teeth two, the anterior one thick and bifid, the posterior thin and longer; laterals in the left valve indistinct. Pallial sinus large and deep, approaching to the anterior muscular impression. A single left valve, 10 millim. in length, 5 millim. in height and 1,2 millim. in depth.

This species may possibly be a *Macoma*, for it is related to *Macoma praemitis* Röm (Syst. Conch. Cab., vol. X, p. 257, pl. 48, figs. 7–9) of our seas, but is longer and more inequilateral. It is also like *Tellina donacina* L. (Forbes a Hanley, Brit. Moll., I. p. 292, pl. XX, figs. 3,4) of the Atlantic, in which, however, the anterior side is wedge-shaped.

Fossil occurrence.—Miyata Zone (Kami-Miyata). Upper Musashino of Musashi, Shimosa, and Kazusa.

Genus ***Macoma***, Leach.

142. **Macoma dissimilis**, (Martens).

Pl. VII. Figs. 19, 20.

Macoma dissimilis. Pilsbry, Cat. Mar, Moll. Japan, p. 125.
Macoma nasuta. Fokunaga, Foss. Env. Tokyo, p. 45, pl. III, fig. 2.
Tellina dissimilis. Martens, Ann. Mag. Nat. Hist., Series III, vol. 16, p. 430.
Tellina nasuta var. dissimilis. Lischke, Jap. Meeresconch., II, p. 115, pl. IX, figs. 15–17.
Tellina nasuta. Brauns, Geol. Env. Tokio, p. 39.

Without going into the discussion of whether *Macoma dissimilis* Mart. is identical with *Macoma nasuta* Conrad or not, I simply say that two right valves with a very strong posterior fold agree quite well with the shell described by Lischke as a variety of *Macoma nasuta* in his work on our marine mollusks. The so-

called *Tellina* (*Macoma*) *nasuta* of the Upper Musashino of the neighbourhood of Tokyo all belong to the present species. Rare.

Fossil occurrence.—Miyata Zone (Shimo-Miyata); Yokosuka Zone (Otsu); Upper Musashino of Oji, Tabata and Shinagawa.

Living.—Central Japan.

143. **Macoma inquinata**, (Deshayes).

Pl. VIII. Figs. 1, 2.

Macoma inquinata. Pilsbry, Cat. Mar. Moll. Jap., p. 124. Arnold, Pal. a. Strat. Mar. Plioc. a. Pleist. San Pedro, p. 162, pl. XVI; fig. 4.

Tellina inquinata. Deshayes, Proc. Zool. Soc. London, 1854, p. 357. Römer in Syst. Conch. Cab., vol. X, pl. 4. p. 227, pl. 44, fig. 1–4. Dunker, Index. Moll., p. 190.

Tellina inquinata var. incongrua. Lischke, Jap. Meeresconch., II, p. 117, pl. X, figs. 12, 13.

Tellina incongrua. Martens, Ann. Mag. Nat. Hist. series III, vol. 16, p. 430. Römer in Syst. Conch. Cab., X, pl. 4, p. 225, pl. 43, figs. 11–13.

This species is distinguished from the preceding by the higher and more swollen form and the ventral margin more quickly ascending to the posterior end.

We possess only a few examples, of which a right valve measuring 31 millim. in length 25 millim. in height and 7 millim. in depth is the largest.

Fossil occurrence in Japan:—Miyata Zone (Nagai) and Yokosuka Zone (Otsu). Upper Musashino of Shimosa.

Fossil occurrence in foreign countries:—Pliocene and Pleistocene of California.

Living:—Northern, Central and Western Japan. Okhotsk Sea. West Coast of America from Alaska to San Diego.

Macoma nipponica, (Tokunaga).

Pl. VIII. Figs. 3, 4.

Tellina nipponica. Tokunaga, Foss. Env. Tokyo, p. 44, pl. II, figs. 36a, 36a'.

Shell transversely oblong, rather thin, somewhat swollen, strongly inequilateral, the anterior side being about one and a half times as long as the posterior. Anterior end rounded, posterior obtusely angulate with a shallow notch below it. Antero-and postero-dorsal margins sloping, the former less steeply

than the latter and somewhat arched. Ventral margin broadly arcuate, anteriorly gradually passing into the rounded anterior margin. Posterior fold of the right valve situated near the posterior margin, distinct but not very strong. An obtuse ridge runs from the beak to the postero-ventral notch, forming a narrow area behind, with an obtuse rib running longitudinally in it. The sculpture consists only of unequal incremental lines which are especially marked on the posterior ridge and rib. Beaks small, pointed. Main teeth two, the anterior in the left valve and the posterior in the right valve being bifid. Lateral teeth indistinct Pallial sinus large and deep, much deeper and higher in the left valve than in the right. Three right valves and one left valve. The left valve measures 19 millim. in length 13 millim. in height and 3 millim. in depth, while the largest right valve measures 26 millim. in length, 18 millim. in height and 5 millim. in depth.

This species is very closely allied to *Macoma truncata* Gould (Philippi's Abbild., I. p. 71, 7, N. 2, pl. 1, fig. 2 and Syst. Conch. Cab. X. pl. 4, p. 248, pl. 47, figs. 4–6) which is living near Tokyo. But so far as we can see from a few specimens which we possess, the shell of the present species is somewhat smaller, less trigonal, the posterior part of the ventral margin somewhat more arcuate and the beaks more pointed than in Jonas species.

Fossil occurrence.—Miyata Zone (Motowada and Nagai); Upper Musashino of Musashi and Kazusa.

Living.—Northern Japan (Bay of Hakodate). Tokunaga mentions Tokyo, Nagasaki, and Yokohama as the habitat. But this assertion has not yet been confirmed, while Hakodate is certain, as there is a specimen from that place in the zoological museum of our University.

Family Veneridæ.

Genus *Dosinia*. Scopoli.

145. Dosinia troscheli, Lischke.

Pl. VIII. Figs. 5, 6.

Dosinia troscheli. Lischke, Jap. Meeresconch., III, p. 89, pl. VIII, figs. 1–3. Dunker, Index Moll., p. 203.

Dosinia exoleta. Brauns, Geol. Env. Tokio, p. 41, pl. VI. fig. 22. Tokunaga, Foss. Env. Tokyo, p. 47.

Only a few specimens were obtained.

Brauns and Tokunaga united this species with the well known Atlantic form *Dosinia exoleta* L. But there are several distinguishing characters between the two. *Dosinia troscheli* is somewhat longer and more flattened than *Dosinia exoleta*. Also the posterior end of the former is more angulate and the anterior end more produced than in the latter. The end of pallial sinus also presents some difference. It is bluntly pointed in the Japanese species, while it is more subtruncate in the European. But, above all, what distinguishes the two on first glance is the presence of an area in our species, while it is absent in Linné species.

A left valve represented in our figure measures 47 millim. in length, 43 millim. in height and 11 millim. in depth.

Fossil occurrence:—Miyata Zone (Shimo-Miyata and Nagai) and Naganuma Zone (Naganuma); Upper Musashino of Musashi Shimosa and Kazusa.

Living:—Central and Western Japan.

Genus *Cyclina*. Deshayes.

149. Cyclina chinensis, (Chemnitz).

Pl. XI. Figs. 7, 8.

Cyclina chinensis. Deshayes, Traité Elémentaire, vol. I, pt. 2, p. 626, pl. 14, figs. 20–22. Pfeiffer in Syst. Conch. Cab. Mart. Chemn., vol. XI, pt. 1, p. 111, pl. 2, fig. 5, pl. 28, fig. 1. Lischke, Jap. Meeresconch., I, p. 126. Brauns, Geol. Env. Tokio, p. 53. Tokunaga, Foss. Env. Tokyo, p. 48.

Venus chinensis. Chemnitz, Conch. Cab., X, p. 356, pl. 171, fig. 1663.

This is a species which lives in great abundance in the Bay of Tokyo. The fossil specimens are also rather numerous, but most-

ly in a broken state. Of the three main teeth, the middle and the anterior in the left valve are bifid.

Fossil occurrence:—Yokosuka Zone (Otsu); Upper Musashino of Musashi.

Living:—Northern (Rikuzen). Central and Western Japan; Formosa, China Sea; Coast of Cochin China.

Genus ***Meretrix***, Lamarck.

147. **Meretrix (Callista) chinensis**, (Chemnitz).

Pl. VIII. Figs. 9,10.

Meretrix (Callista) chinensis. Pilsbry, Cat. Mar. Moll. Jap., p. 127.

Cytherea chinensis. Pfeiffer in Syst. Conch. Cal. Mort. Chemn. vol. XI, pt. I, p. 31, pl. XI, fig. 2. Lischke, Jap. Meeresconch., I, p. 122. Tokunaga, Foss. Env. Tokyo, p. 46, pl. III, fig. 4.

Callista chinensis. Dunker, Index Moll., p., 200.

Venus chinensis. Chemnitz, Conch. Cab., XI, p, 217, pl. 202, fig. 1976.

Venus pacifica. Dillwyn, Catal. I, p. 175, no. 40. Schrenck, Moll. Amurl. u. 2. nordjap. meeres, p. 541.

Only a young right valve and two fragments of a grown shell which, on comparison with the recent specimens, have proved to belong to the above mentioned species.

Fossil occurrence.—Naganuma Zone (Naganuma). Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Northern, Central and Western Japan; China Sea; Australia.

Genus ***Venus***, Linné.

148. **Venus jedoensis**, Lischke.

Pl. VIII. Figs. 11,12.

Venus jedoensis. Lischke, Jap. Meeresconch., vol. III, p. 84, pl. VII, figs. 1–9. Dunker, Index Moll., p. 196.

Many specimens both young and full grown. In the young forms the outline of the shell is more or less elliptical, while in the older ones it is more subquadrate, owing to the subtruncation of the posterior end. The largest specimen which we possess is a left valve, 59 millim. in length, 49 millim. in height and about

15 millim. in depth. It is markedly more quadrate than the shells figured by Lischke. As to the external sculpture, I have to add that in the anterior half of the shell and near the ventral margin there is a small intermediate rib which continues only for a short distance in the direction of the beak. The pallial sinus is short, triangular and blunt at end, as described by Lischke.

Another example which is a right valve 35 millim. in length and 29 millim. in height is also subtruncate at the hinder end, and the anterodorsal margin is more steeply sloping than in most specimens, so that the shape approaches a trapezoid.

Fossil occurrence.—Miyata Zone (Kami-Miyata and Nagai); Yokosuka Zone (Yokosuka and Otsu). Upper Musashino of shimosa.

Living.—Central and Western Japan.

Genus ***Chione***. Megerle von Mühlfeldt.

149. **Chione isabellina**, (Philippi).

Pl. VIII. Fig. 13,

Chione isabellina. Deshayes, Conch. Brit. Mus., I, pl. 124, no. 17. Dunker, Index Moll. Mar. Jap., p. 198.

Venus isabellina. Philippi in Zeitsch. f. Malakoz., p. 188, no. 65, Abbild. III, p. 83, no. 5. Venus, pl. x, fig. 5. Pfeiffer, in Syst. Conch. Cab. Mart. u. Chemn., XI. pt. 1, p. 194, pl. 25, fig. 9.

Shell roundly trigonal, thick, inequilateral, the posterior side about twice as long as the anterior. Anterior end generally rounded, posterior end subangulate or subtruncate; postero-dorsal margin somewhat convex and sloping, antero-dorsal margin slightly excavated. The sculpture consists of concentric erect laminae which are distant, ten to thirteen in number besides several near the beak which are simply rib-like, and separated by wide flat interspaces with only concentric lines of growth. These laminae in the left valve stop suddenly on reaching the areal edge, while in the right valve they continue a little into the area. Lunula ovate, laminated, the laminae looking like continuations of the dorsal ones, only interrupted by the boundary incision. Area lanceolate, most developed in the left valve, longitudinally striated.

Pallial sinus almost horizontal, shallow, triangular to semi-elliptical in form with the apex blunt. Inner margin finely crenulate.

The posterior subtruncation of the shell makes it not unlike *Chione gravescens* Menke (Syst. Conch. Cab. XI, pl. 1, pl. 25, fig. 8) from Australia which, however, has a less number of laminae. The shape of the pallial sinus varies in shape from triangular to semi-elliptical.

The fossil specimens which are tolerably numerous are all small. The largest which is a right valve is 16,5 millim. in length, 15 millim. in height and 5 millim. in depth.

Fossil occurrence.—Naganuma Zone (Naganuma). Upper Musashino of Musashi and Shimosa.

Living.—Japan (according to Dunker): China Sea.

150. **Chione minuta**, Yokoyama.

Pl. VIII. Fig. 14.

Shell small, moderately thick, tumid, trigonal, as high as long, inequilateral. Anterior margin rounded, posterior end roundly angulate, ventral margin broadly arcuate. Surface radiately ribbed; ribs numerous, unequal, straight, separated by about equal interspaces, often with an interstitial riblet towards the ventral margin. Besides the radiating ribs, there are also fine, distant, somewhat lamellar, concentric striae which give the surface a somewhat cancellated appearance. Lunula and area absent. Teeth in the right valve three, the anterior thin and parallel to the antero-dorsal margin, the middle thick and bifid, and nearly vertical, the posterior longer and thicker than the anterior, very oblique, and parallel to the postero-dorsal margin. Muscular impressions elongated, the posterior a little larger than the anterior. Pallial line indistinct, pallial sinus small, triangular, somewhat directed upward. Inner margin crenulated, the crenulations on the anterior side going up very near the beak.

A right valve and a broken left valve. The former measures 5 millim. in length and height, and 2 millim. in depth.

This shell has some resemblance to the one described by

Cossmann and Peyrot under the name of *Timoclea subspadicea* (Conch. Néog. de l'Aquitaine, p. 363, pl. XIV, figs. 36–40) from the Miocene of France in being trigonal, in having radiating ribs, and in the form of dentition, though in other respects there are much differences.

Fossil occurrence.—Naganuma Zone (Naganuma).

Genus ***Circe***, SCHUMACHER.

151. **Circe scripta**, (LINNÉ).

PL. VIII. FIGS. 15, 16.

Circe scripta. DUNKER, Index Moll., p. 201. SOWERBY, Thes. Conch., II, p. 651, pl. 139, figs. 38–43. PILSBRY, Cat, Mar Moll, Jap., p. 128.

Circe undatina. LISCHKE, Jap. Meeresconch., III, p. 87. SOWERBY, Thes. Conch. II, p. 651, pl. 138, figs. 22–26.

Venus scripta. LINNÉ, Syst. ed. X, p. 689, no. 121 ; ed. II, p. 1135, no 145.

Cytherea scripta. LAMARCK, Anim. s. vert., N. p. 575 no. 57. PFEIFFER, in Syst. Conch. Cab., XI, pt. 1. p. 54, pl. 20, figs. 1–4.

Two young valves belonging to a *Circe* described by Lischke and Sowerby as *C. undatina* LAM. and by Pfeiffer as *C. scripta* L. They are very small; the one (right valve) measuring 5,5 millim. in length and 5 millim. in height, and the other (left valve) 7,5 millim. in length and 7 millim. in height. They are both much worn by friction, but their form and other characters exactly agree with those of the recent specimens found near our coast.

Fossil occurrence.—Naganuma Zone (Naganuma).

Living.—Central and Western Japan; Australia; Red Sea.

Genus ***Venerupis***, LAMARCK.

152. **Venerupis irus**, (LINNÉ).

PL. IX. FIG. 1.

Venerupis irus. LAMARCK, Anim. s. vert. V, p. 507. SOWERBY, Thes. Conch., II, p. 763. pl. 164, fig. 1, pl. 165, figs. 31, 32. PHILIPPI, Enum. Moll. Sic., I, p. 21, II, p. 20. WOOD, Crag Moll., Bivalves, p. 205, pl. XIX, fig. 6. MIDDENDORFF, Mal. Ross., III, p. 51.

Rupellaria irus, DUNKER, Index Moll., p. 208 no 111.

A right and a left valve of young shells, and a broken left valve of an adult one.

The right valve which is 8 millim. in length, 5,5 millim. in height and 3 millim. in depth is subquadrate, moderately tumid, and strongly inequilateral, with dorsal and ventral margins nearly parallel. The posterior side is somewhat higher than the anterior, with the anterior margin nearly straight, steeply sloping from the beak and forming a blunt angle with the nearly straight ventral margin. The posterior margin is obliquely truncate, forming angles both with the dorsal and ventral margins, the angle with the former being rather sharp, while that with the latter is more rounded. The surface has an obtuse or flattened edge running from beak to postero-ventral corner, and is ornamented with fine radiating, somewhat sinuous striae crossed by distant concentric laminae which are, however, mostly water-worn. Pallial sinus distinct, roundly triangular with apex somewhat pointed. The left valve of a young shell is a little larger, being about 12 millim. long and 8 millim. high. It is similarly shaped.

Fossil occurrence in Japan.—Yokosuka Zone (Otsu and Yokosuka).

Fossil occurrence in foreigen countrtes:—RedCrag of England; Pliocene of Italy.

Living.—Central Japan; Atlantic, from Mediterranean to Britain.

153. **Venerupis insignis,** Deshayes.

Pl. IX. Figs. 2,3.

Venerupis insignis. Deshayes, Proc. Zool. Soc. Lond., 1853, p. 6, pl. fig. 3,4. Sowerby, Thesaur. Conch., II, p. 765, pl. 164, figs. 5,6. Dunker, Ind. Moll. Mar. Jap., p. 209.

Sowerby's diagnosis runs as follows:

,, Shell irregular, strong, tumid, radiately striated, and irregularly and concentrically subfoliated. reddish violet within, dark at margin, externally golden, violet towards margin; inner margin smooth."

We possess many specimens large and small, oblong, trapeziform, round, etc. in shape. Most of them, however, are devoid of foliations by rubbing. Pallial sinus semi-elliptical, distinct. The

comparison with recent forms leaves no doubt of their being identical with Deshayes species.

Fossil occurrence.—Yokosuka Zone (Otsu and Yokosuka).

Living.—Central Japan; New Zealand.

Genus ***Tapes***, Megerle von Mühlfeldt.

154. **Tapes variegatus**, Hanley.

Pl. IX. Figs. 4,5.

Tapes variegatus. Sowerby, Thes. Conch., II, p. 696, pl. 151, figs. 133–138. Lischke, Jap. Meeresconch., I., p. 118, II, p. 108, III, p. 79. Dunker, Ind. Moll., p. 209.

Venus variegata. Pfeiffer in Syst. Conch. Cab., XI, pt. 1, p. 223, pl. 38, figs. 2–5.

Two right and three left valves, all of young shells. They are rather thin, transversely elliptical, strongly inequilateral, rather compressed and ornamented with numerous, close, radiating riblets crossed by incremental lines. Lunula broadly lanceolate, bounded by indistinctly impressed lines. Area lanecolate, also not very distinct. Pallial line not exposed, being covered with sands firmly attached to the inner side of the shells.

All the specimens belong to a comparativly longer forms, the proportion of length to height being about ten to six and a half. The largest one (right valve) measures 16 millim. in length, 10 millim. and 3,5 millim. in depth.

Fossil occurrence.—Miyata Zone (Kami-Miyata).

Living.—Central and Western Japan; Philippines.

155. **Tapes philippinarum**, (A. Adams et Reeve).

Pl. IX. Fig. 6.

Tapes philippinarum. Lischke, Jap. Meeresconch., 11. p.115, II, p. 108, III, p. 78. Pilsbry, Cat. Mar. Moll. Japan, B. 130. Sowerby, Thes. Conch., II, p. 694, pl. 151, figs. 139–141. Dunker, Ind. Moll. p. 207.

Venus philippinarum. Adams and Reeve, Voy. Samarang, Mollusca, p. 79, pl. XXII, fig. 10. Pfeiffer in Syst. Conch. Cab., XI, pt. 1, p. 230, pl. 39, figs. 7,8.

Venus decussata var. japonica. Dunker, Moll, Jap., p. 26.

Venus decussata. Schrenck, Nordjap. Moll., p. 533. Brauns, Geol. Env. Tokyo, p. 53.

Venus decussata var. philippinarum. Tokunaga, Foss. Env. Toyko, p. 49, pl. III, fig. 7.

Tapes japonica. Deshayes, Proc. Zol. Soc. Lend. 1853, p. 10.

Venus indica. Pfeiffer in Syst. Conch. Cab., XI, pt. 1, p. 225, pl. 38, figs. 8–11.

Without going into the discussion of whether *Tapes philippinarum* Ad. and Rve is not identical with *Tapes decussatus* L. of the Atlantic as maintained by some, it is simply to be mentioned that the various specimens found as a fossil in the neighbourhood of Tokyo and Yokohama all agree with those now living in the Japanese waters. From the foregoing species, the present one is distinguished by its shorter and more swollen form. The largest specimen (right valve) in our collection measures 40 millim. in length, 29 millim. in height and 10 millim in depth.

Fossil occurrence:—Yokosuka Zone (Otsu); Upper Musashino of Musashi, Kazusa and Shimosa.

Living:—Northern, Central and Western Japan; Philippines; Indian Ocean.

156. **Tapes amabilis,** (Philippi).

Pl. IX. Fig. 7.

Tapes amabilis. Lischke, Jap. Meeresconch., vol. III, p. 82, pl. VI, figs. 5–7. Dunker, Index Moll., p. 206. Sowerby, Thes. Conch., II, p. 680, fig. 11.

Venus amabilis. Philippi, Abbild. III, p. 75, Venus, pl. VII, fig. 2.

Several, though incomplete, specimens of an externally concentrically furrowed *Tapes* agree fairly well with the one described by Lischke as a variety of *Tapes amabilis* Phil.

The Japanese specimens of *Tapes amabilis* show a great resemblance to *Tapes schnellianus* Dunker (Nov. Conch., p. 75, pl. XXV, figs. 7–9) also found in the Japanese waters. By examining the recent examples of the two, *Tapes amabilis* is longer and more flattened than *Tapes schnellianus*, and the pallial sinus in the former is rounded at end, while in the latter it is truncate. But in our fossil specimens whose form is exactly like that of Philippi species, the sinus is also truncate like that of Dunker species. It is of course not yet certain whether this character is constant or not, but it shows at least that not much weight can be laid on the form of the sinus in distinguishing the two.

Fossil occurrence:—Naganuma Zone (Naganuma).

Living:—Central and Western Japan.

Genus ***Saxidomus***, Conrad.

157. **Saxidomus purpuratus**, (Sowerby).

Pl. IX. Figs. 8, 9.

Saxidomus purpuratus. Deshayes, in Cat. Conch. Brit. Mus. p. 188. Lischke, Jap. Meeresconch., I, p. 127. Dunker, Index Moll. p. 206. Brauns, Geol. Env. Tokio, p. 40, pl. V. fig. 20.

Saxidomus Nuttali. Conrad, Journ. Acad. Sci. Philad., 1837, VII. p. 249, pl. XIX, fig. 12. Pfeiffer, in Syst. Conch. Cab., X. pt. 1. p. 242. pl. 37, figs. 2–4. Schrenck, Nordjap. Moll., p. 253. Tokunaga, Foss. Env. Tokyo, p. 45.

Saxidomus giganteus. Martens in Preuss. Exped. nach Ostasiens, zool. Abth., vol. I, pt. 1, p. 140.

This is a very common shell in the Musashino formation of the neighbourhood of Tokyo. It is large, transversely oval, thick, swollen, deeply purple within in the living specimens. The muscular and mantle impressions are deep and distinct, with the pallial sinus deep and finger-like. The fossil specimens which we possess are not very large, the largest measuring 83 millim in length and 65 millim in height. We have nothing to add to the minute descriptions given by Lischke.

Frequent.

Fossil occurrence:—Yokosuka Zone (Otsu and Yokosuka); Upper Musashino of Musashi, Kazusa and Shimosa.

Living:—Northern, Central and Western Japan; Sitka; California; Chile; Bonin Islands; Indian Ocean.

Family **Cardiidæ**.

Genus ***Cardium***, Linne.

158. **Cardium californiense**, Deshayes.

Pl. IX. Fig. 10.

Cardium californiense. Deshayes, Revue Zool. p. 1. Soc. Cuvierienne, p. 360. Middendorff, Sib. Reise, Meeres-Mollusken, p. 218, pl. XIX, figs. 6–11. Mal. Ross. III, p. 40, pl. XV, figs. 23–25. Schrenck, Nordjap. Moll., p. 514. Lischke, Jap. Meeresconch., I, p. 144, III, p. 125. Brauns, Geol. Env. Tokio, p. 42. Tokunaga, Foss. Env. Tokyo, p. 50, pl. III, fig. 5.

Several young specimens and a moderately grown left valve. All these fossil forms have the anterior margin not quite rounded as in the living ones described by Middendorff, but subangulated. A left valve represented in the figure, 33 millim. long, 27 millim.

high and 10 millim deep, shows this character in a marked degree, a character which is also seen in some of our recent specimens. The above valve has about thirty-three ribs besides those found in the posterior area.

Fossil occurrence:—Miyata Zone (Kami-Miyata, Shimo-Miyata and Okine Nagai); Yokosuka Zone (Otsu); Upper Musashino of Musashi, Kazusa and Shimosa.

Living:—Northern to Western Japan; Behring Sea; British Columbia; California.

159. **Cardium muticum,** Reeve.

Pl. IX. Fig. 11.

Cardium muticum. Reeve, Conch. Icon., Cardium, pl. VI, fig. 32. Lischke, Jap. Meeresconch., I, p. 144. Brauns, Geol. Env. Tokio, p. 42. Tokunaga, Foss. Envir. Tokyo, p. 50, pl. III, fig. 10. Dunker, Ind. Moll., p. 212. Pilsbry, Cat. Mar. Moll. Jap., p. 131.

Cardium papyraceum. Römer in Syst. Conch. Cab., Mart. u. Chemn., vol. X, pt. 2, p. 78, pl. III, fig. 4, pl. XII, figs. 19, 20.

Cardium japonicum. Dunker, Moll. Jap., p. 28, pl. III, fig. 16.

The shell is large, but very thin and fragile, suborbicular and subequilateral, ornamented with numerous radiating riblets which are flat and hardly elevated above the surface of the shell except at the sides where they are more or less ridge-like. Their number is over forty, each subdivided into two by a fine impressed punctuated line. Beaks tumid. Our largest example measures about 75 millim. in height, a little over it in length, and 29 millim. in depth (right valve). Rare.

Fossil occurrence:—Miyata Zone (Kami-Miyata and Nagai); Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma); Upper Musashino of Musashi and Shimosa.

Living:—Northern, Central and Western Japan; Philippines; East Indies.

160. **Cardium modestum,** A. Adams et Reeve.

Pl. IX. Figs. 12, 13.

Cardium modestum. Adams and Reeve, Voy. Samarang, Zool., p. 77. pl. XXII, fig. 6. Dunker, Index Moll., p. 211. Pilsbry, Cat. Mar. Moll. Jap., p. 131.

Shell moderate in size, thin, roundly subquadrate, swollen, somewhat inequilateral; anterior margin rounded, going over gradually into the sloping antero-dorsal margin as well as into the weakly convex ventral margin; posterior margin obliquely truncate, or sometimes even slightly concave, forming a rounded angle with the ventral margin and an obtuse one with the postero-dorsal margin. Surface with a blunt KEEL running from beak to postero-ventral corner, the space bounded by it and the posterior margin being depressed in the middle, and ornamented with numerous straight radiating striae crossed by fine concentric lines. The other part of the surface is also sculptured with the same kind of radiating striae which are not so sharp and distinct as on the posterior surface. Beaks tumid, pointed. Inner margin of the shell finely crenulate. The largest specimen (left valve) measures about 28 millim. in length, 16 millim. in height and 10 millim. in depth. A somewhat smaller right valve measures 24.5 millim. in length, 23 millim. in height and 9 millim. in depth. Frequent.

Fossil occurrence:—Koshiba Zone (Koshiba). Lower Musashino of Kazusa.

Living:—Central Japan.

161. **Cardium braunsi**, TOKUNAGA.

PL. X., FIG. 1.

Cardium braunsi. TOKUNAGA, Foss. Env. Tokyo, p. 51, pl. III, fig. 11.

Shell large, thick, ovately trigonal in outline, ventricose, somewhat inequilateral; anterior margin rounded, posterior margin only little convex, forming a rounded angle with the convex ventral margin. Surface radiately ribbed; ribs twenty-three to twenty-six, elevated, nearly flat-topped, quadrate in cross-section, separated by interspaces more or less narrower than the ribs themselves. Incremental lines distinct, making the ribs appear somewhat telescopic.

A single specimen of a left valve lacking the posterior half. It is 67 millim. high, 29 millim. deep and about 70 millim. long and exactly agrees with the species first described by Toku-

naga from the Upper Musashino of Oji under the name of *Cardium braunsi*. The specimens from Oji have the surface strongly eroded and worn, which is not the case in ours.

This species resembles *Cardium tuberclatum* L. (Syst. Conch. Cab., vol. x, pt. 2, pl. V, fig. 1) of the Atlantic and also *Cardium nuttalli* Reeve (Conch. Icon., Cardium, pl. 13, fig. 66) of the north-west coast of America in both of which, however, the ribs are nodulously crenate. There are also some differences in shape.

Fossil occurrence.—Miyata Zone (Kami-Miyata). Upper Musashino of Musashi, Kazusa and Shimosa.

Family **Diplodontidæ.**

Genus ***Diplodonta***, Bronn.

162. Diplodonta usta, (Gould).

Pl. IX. Figs. 14–16.

Diplodonta usta. Pilsbry, Cat. Mar. Moll. Jap., p. 133. Yamakawa, On Diplodonta (Felariella) usta Gould (Japanese), Jour. Geol. Soc. Tokyo, 1909, vol. 16, p. 482, pl. XIV, figs. 1–10.

Mysia (Felaria) usta. Gould, Otia Conchologica, p. 170.

Mysia pacifica. Tokunaga, Foss. Env. Tokyo, p. 53.

Diplodonta trigonula. Brauns, Geol. Env. Tokio, p. 44, pl, VI, fig. 25 (non D. trigonula Bronn).

The shell is roundly ovate, somewhat oblique, moderate in thickness and tumidity, inequilateral, the anterior side somewhat shorter than the posterior; anterior and posterior margins rounded, passing gradually both into the ventral and the dorsal margins; sometimes, however, the anteror margin may be subtruncate. Surface concentrically and unequally striated. Inner surface with radiating lines and a rib running from beak to the anterior muscular impression. The pallial line is very distinct. The teeth are two in each valve, the anterior tooth in the left valve and the posterior in the right valve being bifid; the anterior tooth in the right valve is thick and triangular, while the posterior in the left valve is thin and ridge-like. The largest specimen in our possession is a right valve, 35 millim. in length, 32 millim. in height and 9 millim. in depth. The proportion of length to height is variable. The late Yamakawa who made accurate measurements in many

fossil specimens from the Upper Musashino of the vicinity of Tokyo found it to be 100 to 87–100. It is the merit of this lamented palaeoconchologist in pointing out the errors committed both by Brauns and Tokunaga in naming this species *Diplodonta trigonula* Bronn and *Mysia pacifica* n. sp. respectively.

Frequent.

Fossil occurrence.—Miyata Zone (Kami-Miyata and Nagai); Upper Musashino of Musashi and Shimosa.

Living.—Northern and Central Japan (Hitachi).

163. **Diplodonta semiaspera**, (Philippi).

Pl. X. Figs. 2,3.

Diplodonta semiaspera. Philippi, Archiv für Naturg., I, 1836, p. 225, pl. VII, fig. 2. Dunker, Index Moll., p. 218.

The shell is thin, swollen, slightly inequilateral, roundly ovate in outline, anterior side narrowed and obtusely ending, the posterior margin broadly rounded. Surface only with unequal concentric lines of growth. Beaks small and pointed. Muscular impressions pear-shaped, often tolerably elongated.

The largest specimen (left valve) in our possession measures 18 millim. in length, 16 millim. in height and 9 millim. in depth. A right valve of a living shell from Awa (Bōshū) measures 21,5 millim. in length, 17,5 millim in height and 9,5 millim in depth.

Rare.

Fossil occurrence.—Miyata Zone (Shimo-Miyata); Koshiba Zone, (Koshiba). Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Central and Western Japan; West Indies; Mazatlan; Patagonia.

164. **Diplodonta japonica**, Pilsbry.

Pl. X. Fig. 4.

Diplodonta japonica. Pilsbry, Cat. Mar. Moll. Japan, p. 132, pl. III, figs. 6,7.

A single left valve, 17,5 millim. long, 15,5 millim. high and 7 millim. deep.

This species resembles the preceding, but is distinguished from it by the smaller size, the more straight hinge-line and the greatest length being in the upper half of the shell near the hinge-line. Also the concentric costellae of the surface often consist of rows of elongated granules, especially in the middle portion of the shell.

Fossil occurrence.—Naganuma Zone (Naganuma). Upper Musashino of Shimosa.

Living.—Central Japan.

165. **Diplodonta gouldi**, Yokoyama.

Pl. X. Fig. 5.

Shell small, moderately thick, roundly oval, somewhat oblique, only slightly inequilateral, anterior and posterior margins rounded, the latter more broadly than the former; dorsal margin sloping on both sides, the antero-dorsal passing gradually into the anterior margin, while the postero-dorsal forms a rounded obtuse angle with the posterior margin. The broadest part of the shell is nearly in its middle. The sculpture consists of unequal incremental lines. Main teeth two, the anterior tooth in the left valve and the posterior in the right being bifid. Muscular impressions more or less elongated, longly pear-shaped. Length 15 millim., height 13 millim., thickness (two valves together) 7 millim.

This species resembles *Diplodonta semiaspera* in outline, but is much flatter.

Fossil occurrence.—Miyata Zone (Kami-Miyata).

Living.—Central Japan (Sagami Bay).

Family **Lucinidae**.

Genus ***Lucina***, Bruguière.

166. **Lucina pisidium**, Dunker.

Pl. X. Fig. 6.

Lucina pisidium. Dunker, Moll. Jap., p. 28, pl. III, fig. 9. Index Moll., p. 216. Lischke, Jap. Meeresconch., II, p. 133. Pilsbry Cat. Mar. Moll. Jap., p. 133.

Lucina parvula. Gould, in Proc. Boston Soc. Nat. Hist., vol. VIII, p. 36 (April, 1861); Otia Conch., p. 174.

Shell small, moderate in thickness, almost orbicular, nearly equilateral, rather convex, concentrically and radiately striated; concentrical striae often elevated and lamellar; radiating striae fine, numerous, often obliterated, especially in the middle portion of the shell, divergent at the anterior as well as at the posterior side. Inner margin finely crenulate. Lunula ovate, deep. The proportion of length to height is more or less variable, some shell being higher than long. But normally the length is a little greater than the height. Our largest example is a left valve 10 millim. both in length and height, and 4 millim. in depth. Not rare.

Fossil occurrence:—Miyata Zone (Okine); Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma). Upper Musashino of Shimosa.

Living:—Northern, Central and Western Japan: Ryukyus; Bonins; New South Wales.

167. Lucina borealis, (Linné).

Pl. X. Fig. 7.

Lucina borealis. Forbes and Hanley, Brit. Moll., II, p. 46, pl. 35, fig. 5. Pfeiffer in Syst. Conch. Cab. Mart. Chemn., vol. XI, pt. 1, p. 256, pl. 9, fig. 1. Wood, Crag Moll., Biv. p. 139, pl. XII, fig. 1. Nyst, Conch. Terr. Tert. de Belgique, p. 176, pl. XIX, fig. 2, Brauns, Geol. Env. Tokio, p. 44. Tokunaga, Foss. Env. Tokyo, p. 52.

Lucina radula. Philippi, Enum. Moll. Sic., I, p. 35, pl. III, fig. 17, II, p. 25. Gould, Invert. Massach., p. 69.

Lucina antiquata. Nyst, Coq. Foss. de Belg., p. 128, pl. 6, fig. 7.

Lucina flandrica. Nyst, Coq. Foss. de Belg., p. 127, pl. 6, fig. 6.

Venus borealis. Linné, Syst. Nat., ed. 12, p. 1134, No. 143.

This is a very common shell in the Upper Musashino of Oji; but it is here represented by only a few specimens. The one from Yokosuka with both valves complete is 30 millim. in length and height, and 16 millim. in depth, nearly orbicular in outline and with the usuall lamellar concentric striae whose interspaces are ornamented with fine concentric lines. No essential difference is to be found between it and the Oji specimens or the European ones.

Fossil occurrence in Japan:—Miyata Zone (Shimo-Miyata);

Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma); Upper Musashino of Musashi and Shimosa.

Fossil occurrence in foreign countries.—Glacial and Pliocene of England; Scaldisien of Belgium; Pliocene of Italy; Miocene of Austria, Poland, Volhynia in Russia, Switzerland, etc.

Living:—Central Japan: Atlantic (Iceland, Norway, Great Britain, Holland, France, the Eastern Coast of North America) and Mediterranean.

168. **Lucina contraria**, Dunker.

Pl. X. Fig. 8.

Lucina contraria. Dunker, Index Moll. Maris Japon., p. 215, pl. XIII, figs. 12–14.
Lasaea striata. Tokunaga, Foss. Env. Tokyo, p. 53, pl. III, fig. 14.
Lasaea rubra. Brauns, Geol. Envir. Tokio, p. 43.

A few examples. The shell is orbicular in shape and strongly convex with the ventral border crenulated. The surface shows irregular concentric riblets crossed by fine radiating striae. Height 11 millim. Breadth 105 millim. Depth 4,5 millim.

What Tokunaga described as *Lasaea striata* is undoubtedly this species; I was convinced of this on studying the specimens from Oji and Shinagawa. He was probably right in identifying *Lasaea rubra* Mont. of Brauns with his species.

Fossil occurrence:—Miyata Zone (Shimo-Miyata and Kami-Miyata); Upper Musashino of Musashi and Shimosa.

Living:—Central Japan.

169. **Lucina spectabilis**, Yokoyama.

Pl. X. Figs. 10, 11, 12.

Shell large, moderately thick and swollen, transversely roundly ovate, longer than high, somewhat inequilateral, the anterior side being shorter than the posterior; anterior end somewhat produced, narrowed and obtuse, posterior margin broadly rounded, passing gradually into the arcuate ventral margin, but making an obtuse angle with the sloping postero-dorsal margin; antero-dorsal margin sloping and slightly excavated. The

sculpture consists of many distant concentric elevated striae with interspaces also concentrically finely striated. Beaks small. Lunula lanceolate, bounded by sharp edges, longitudinally striated. Main teeth two, the anterior tooth in the left valve and the posterior in the right valve bifid; the anterior lateral of the right valve rather prominent. Anterior muscular impression very much elongated, parallel-sided; posterior muscular impression longly ovate.

There are two specimens; the one is smaller, but has both valves complete, being 66 millim. long, 58 millim. high and 33 millim. thick; the other is larger, but only with the right valve which is 74 millim. long, 67 millim. high and about 21 millim. deep.

This is a species closly resembling the preceding, the main distinctions being its larger size, the narrowed anterior end, and somewhat more inequilateral shell. But of the two specimens above mentioned, the larger one is more like *Lucina borealis* in form than the other, and there is a doubt whether our specimens are not a variety of this well known Linnean species. But at present, I am not able to decide this question, the acquired specimens being so few.

Fossil occurrence.—Koshiba Zone (Koshiba).

170. **Lucina yamakawai**, Yokoyama.

Pl. X. Fig. 9.

A single right valve.

Shell small, moderately thick, tumid, almost equilateral, squarely orbicular, slightly longer than high; anterior margin rounded, passing gradually into the rounded ventral margin; posterior margin subtruncate, forming an obtuse angle with the sloping postero-dorsal margin as well as with the ventral margin, the angle with the former being sharper than that with the latter; antero-dorsal margin slightly excavated. The surface shows an obtuse keel running from beak to postero-ventral angle, the space behind which is somewhat depressed in the middle. The sculpture consists of fine radiating striae crossed by distant con-

centric ones. Lunula deep and ovate. Anterior lateral tooth distinct. Inner side of the shell with fine radiating lines which end at the pallial impression. Muscular scars distinct, the anterior subfusiform and not much elongated, the posterior rather ovate in outline. Inner margin finely crenulate. Length 8 millim., height 7,5 millim., depth (of one valve) 2,5 millim.

This species is very much like *Lucina pisidium* above mentioned, but the radiating striae are decidedly finer, and not divergent.

Fossil occurrence.—Miyata Zone (Shimo-Miyata).

Family **Chamidæ.**

Genus ***Chama***, Linné.

171. **Chama semipurpurata**, Lischke.

Pl. X. Figs. 13, 14.

Chama semipurpurata. Lischke, Jap. Meeresconch., vol. II, p. 130, pl. VIII, fig. 1. Pilsbry, Cat. Mar. Moll. Jap., p. 134.

The shell is thick and ovate; the free portion of the attached or left valve is erect and high, with the anterior margin more or less rounded; the right or free valve only a little convex, roundish or oval. The sculpture consists of closely-set scales concentrically arranged and assuming the form of half-open tubes and spines. These scales are most developed on the free valve. Frequent.

The examples are mostly small, the largest attached valve measuring 25 millim. in height and 22 millim. in length.

Fossil occurrence.—Miyata Zone (Kami-Miyata, and Okine); Yokosuka Zone (Otsu). Upper Musashino of Shimosa and Kazusa.

Living.—Central and Western Japan.

Family **Carditidæ.**

Genus ***Cardita***, Bruguière.

172. **Cardita variegata**, Bruguière.

Pl. X. Fig. 16.

Cardita variegata. Bruguière, Encycl. meth. vers., p. 407. Reeve, Conch. Icon., fig. 2. Clessin in Syst. Conch. Cab. Mart. Chemn., vol. X, pt. 1, p. 23, pl. 3, figs. 8, 9, pl. XI, figs. 5, 6. Pilsbry, Cat. Mar, Moll. Jap., p. 135.

A single left valve, 16 millim. in length, 10 millim. in height and 5 millim. in depth. It is moderately thick, convex, very inequilateral, trapezoidal, posteriorly broadened, anterior side very short, ornamented with about twelve radiating ribs which carry spines on the posterior ones. The ventral margin is somewhat concave. The specimen represents a young state of the species.

Fossil occurrence:—Miyata Zone (Shimo-Miyata).

Living:—Central Japan.

173. **Cardita cumingiana**, Dunker.

Pl. X. Fig. 16. Pl. XI. Fig. 1.

Cardita cumingiana. Dunker, Moll. Jap., p. 29, pl. III, fig. 18. Index Moll. p. 221.

This is a species closely allied to the preceding one, but is distingiushed by a greater number of ribs which are fifteen or sixteen, rarely more. These ribs, which in their nodulous or even spiny character resemble those of *Cardita variegata*, are more or less inverted v-shaped in the anterior portion of the shell, while posteriorly they become more rounded. The anterior ribs, moreover, often possess a weak longitudinal furrow on both sides of their declivities and near their base, so that they appear to subdivide into riblets.

Whether *Cardita leana* Dunker (Moll. Jap., p. 29, pl. III. fig. 17) is only a variely of this species, as thought by Pilsbry (Cat., p. 135), is a question which I can not decide at present.

Frequent.

Fossil occurrence.—Yokosuka Zone (Otsu and Yokosuka).

Living.—Central and Western Japan.

Genus ***Venericardia***, Lamarck.

174. **Venericardia cipangoana**, Yokoyama.

Pl. XI. Fig. 2.

Venericardia compressa. Yokoyama, Verstein. a. d. jap. Kreide, Palaeontographica, vol. XXXVI, p. 196, pl. XXV, fig. 4.

In 1889, I described a series of Cretaceous fossils from the Hokkaido among which there happened to be a species of *Venericardia* which I then took for Cretaceous and named *Venericardia compressa*, but which I subsequently found out to be a Tertiary fossil mixed up by chance with the Cretaceous ones. A few specimens of the same species also occur in the Lower Musashino of the Miura Peninsula which I characterize as follows:

Shell rather small, solid, more or less compressed, inequilateral, somewhat variable in shape from roundly trigonal to sharply trigonal; anterior margin rounded; posterior margin subtruncate, making the postero-ventral corner subangulate: ventral margin broadly convex to nearly straight. The sculpture consists of rounded radiating ribs fourten to sixteen in number, wider than their intervals and often subgranose on account of coarse incremental lines crossing them; these ribs are sometimes much flattened, especially toward the ventral margin where they are usually smooth. Beaks small, pointed. Anterior muscular impression bean-shaped, posterior oval; pedal scar semicircular, just above the anterior muscular impression. Lunula small, but distinct, bounded by sharp edges, ovate, rather smooth. Inner margin coarsely crenate.

The largest specimen at hand is a left valve of a sharply trigonal shape, 20 millim. in length, 16 in height and 6 in depth. Another left valve more roundly trigonal in shape is 19 millim. in length, 15 in height and 5 in depth.

This species is very closely allied to *Venericardia subaffinis* Tournr. (Cossmann at Peyrot, Conch. Néog. de l'Aquitaine, vol, II, pt 1, p. 70. pl. III, figs. 21–24) from the Miocene of France from which it is hardly distinguishable but for the flattened posterior side of the latter. Therefore it is not at all impossible that these two may turn out to be the same species.

The reason why the original name *compressa* has been changed to a new one is because the former is preoccupied by Reeve for a recent species from Chile.

Fossil occurrence.—Miyata Zone (Shimo-Miyata); Naganuma

Zone (Naganuma). Miocene of Poronai (very numerous). Upper Musashino of Shimosa and Kazusa.

Living.—Central and Western Japan.

175. **Venericardia ferruginea**, Adams.

Pl. XI. Figs. 3, 4.

Cardita ferruginea. Clessin in Syst. Conch. Cab. Mart. Chemn., vol. X, pt. 1, p. 17, pl. 6, fig. 11. Pilsbry, Catalogue p. 135.

Cardita rotundi. Tokunaga, Foss. Env. Tokyo, p. 55, pl. III, fig. 17.

Shell small, ovate to roundly trigonal in outline, thick, moderately tumid, very inequilateral; anterior as well as posterior margin rounded, the former more narrowly than the latter; ventral margin broadly arcuate, or even almost straight, in which latter case the postero-ventral corner is more or less subangulate. The surface is ornamented with about twenty radiating ribs separated by much narrower interspaces. These ribs are rounded, but somewhat flattened toward the ventral margin and made more or less nodose by concentric impressed lines. Beaks prominent, pointed. Lunula very small, but deep and cordate. Hinge-teeth two; the anterior in the left valve is very short, while that of the right valve is large and obliquely triangular; the posterior tooth elongated, especially in the left valve. Inner margin crenate.

The shell is very variable in shape and thickness. The length may be equal to the height, or a little greater. The thickness varies from 6 to 8, if we take the length for 10. The largest specimens of both fossil and recent shells in our possession measure about 19 millim. in length.

Tokunaga described this species as new, giving its more rounded shape, more prominent umbones and less thickness as its distinguishing characters. But hundreds of fossil specimens which we possess show all grades of differences in shape.

Very frequent, especially at Kami-Miyata.

Fossil occurrence.—Miyata Zone (Mukaibatake in Shimo-Miyata, Yamagayado and Iwaiguchi in Kami-Miyata, Motowada and a place simply labeled Kami-Miyata); Yokosuka Zone (Isemachi, east of Otsu); Kanazawa Zone (Kanazawa); Koshiba

Zone (Koshiba); Naganuma Zone (Kikkōzan and Naganuma); Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Northern Japan (Hakodate).

Family **Astartidæ**.

Genus ***Astarte***, Sowerby.

176. **Astarte hakodatensis**, Yokoyama.

Pl. XI. Figs. 5, 6.

Shell small, thick, compressed, ovately-trigonal, nearly equilateral, posteriorly broadly rounded, or even subtruncate, anteriorly more sharply rounded, sometimes even bluntly angulate, ventrally broadly arcuate; antero-dorsal margin slightly concave, postero-dorsal somewhat convex; surface coarsely and irregularly grooved; beaks pointed, prominent; lunule short-lanceolate, distinctly bounded by edges; area elongated; muscular impressions deep and distinct; inner margin crenulate.

Generally rare, though less so at Koshiba.

There are some variations in shape, especially in the form of anterior margin. The largest specimen is that of a left valve from Koshiba which is 12 millim. long, 11 millim. high, and 3,5 millim. deep. Another one which is a left valve is 10 millim. long, 9,5 millim. high and 3 millim. deep.

There are apparently two living species of *Astarte* in Northern Japan which are still undescribed. The one is this *Astarte hakodatensis*, while the other is a thinner, longer and posteriorly truncate form with the posterior side longer than the anterior and the inner margin smooth.

Tokunaga also described a species of *Astarte* from the Upper Musashino of Shinagawa under the name of *Astarte japonica* which, however, differs from ours in having a more rounded shape and a smooth inner margin.

Among the fossil species hitherto described from Europe, *Astarte parvula* Wood (Crag Moll., Bivalves, p. 175, pl. XVII, fig. 11) and *A. parva* Wood (loc. cit., p. 192, pl., XVII, fig. 12) from the English Crag have some resemblance in shape to the Japanese, but both possess the inner margin smooth.

Fossil occurrence.—Miyata Zone (Motowada); Koshiba Zone (Koshiba); Naganuma Zone (Kikkozan). Lower Musashino of Kazusa.

Living.—Northern Japan (Bay of Hakodate).

Genus ***Woodia***, Deshayes.

177. **Woodia concentrica**, Yokoyama.

Pl. XI. Fig. 7.

Shell small, moderately thick, flatly convex, nearly orbicular, almost equilateral; anterior and posterior borders roundly truncate, the truncation being more marked in the posterior than in the anterior border; surface concentrically striated, with striae unequally distant and somewhat lamellar, though becoming obsolete toward the beak; a rounded edge runs from the beak to the postero-ventral corner, the surface behind it being slightly concave. Inner margin flattened and forming a smooth narrow field. Muscular impressions ovate.

We possess only two specimens of the right valve, both measuring 4 millim. in height and length, and 13 millim. in depth. The teeth consist of one main tooth and of a distinct anterior and posterior lateral.

This species is closely related to *Woodia digitaria* (L.) found in the English Crag (Wood, Bivalves, suppl. p. 141, pl. X, fig. 8) and in the Atlantic, but lacks the oblique elliptical markings of the latter.

Fossil occurrence.—Naganuma Zone (Naganuma).

Family **Crassatellidæ.**

Genus ***Crassatella***, Lamarck.

178. **Crassatella heteroglypta**, (Pilsbry).

Pl. XI. Figs. 10, 11.

Crassatellites heteroglypta. Pilsbry. Cat. Mar. Moll. Jap., p. 135.

Crassatella japonica. Sowerby, Jour. Linn. Soc. XX, p. 399, pl, XXV, fig. 19. Not Crassatella Japonica Dunker.

Sowerby described this species as follows:

,,Shell ovately trigonal, strong, inequilateral, dark yellow with dark radiating lines, beaks pointed, near together; dorsal area moderately excavated on both sides; anterior border roundly arcuate, posterior biangulated, postero-dorsal margin straight and sloping."

To this he adds that the rough irregular striation in place of the ordinary grooves is peculiar.

We possess a few perfect specimens from Naganuma, one of which is 33 millim. long, 27 millim. high and 17 millim. thick, and a left valve from Okine 28 millim. long, 23 millim. high, and flatter in comparison to the above, being only 5 millim. deep. The so-called biangular character of the posterior border is caused by an oblique truncation which makes the postero-dorsal angle obtuse and the postero-ventral angle rather sharp. The edge running from the beak to the postero-ventral angle is distinct, though rather blunt. The ventral margin is broadly arcuate with the portion near the posterior margin slightly concave. The inner margin of the shell is finely crenulate, a character strangely not mentioned by Sowerby.

Fossil occurrence.—Miyata Zone (Nagai); Naganuma Zone (Naganuma).

Living.—Central and Western Japan.

179. Crassatella oblongata, Yokoyama.

Pl. XI. Figs. 8, 9.

Shell rather small, moderate in thickness and convexity, somewhat inequilateral, transversely oblong, rounded in front and truncate behind, the truncated end forming nearly a right angle with the broadly arcuate ventral margin, though its corner is blunt. Surface with many, equal, concentric, rounded ribs whose number varies betwen twenty-five and thirty, and which are about as broad as the spaces between; a rounded edge runs from the beak to the postero-ventral corner, with the surface behind it slightly depressed. Lunula longly ovate, bounded by sharp edges. Area

lanceolate, distinct. Inner margin finely crenulate. The largest specimen measures 16 millim. (10) in length, 12 millim. (8,3) in height and 9 millim (5,6) in thickness. Another specimen measures 15 millim. (10) in length, 12.5 millim. (7.5) in height and 10 millim. (6,6) in thickness.

This species closely resembles *Crassatella sublamellata* Kobelt (Syst. Conch, Cab., XII, pl. 1, Crassatella, p. 25, pl. 7, fig. 11) living in our seas which is, however, flatter and transversely more elongated, with a less number of ribs. *Crassatella simplex* Kobelt (loc. cit. pl. 7, fig. 10). whose habitat is unknown also resembles our fossil, though the inner margin is smooth.

Fossil occurrence.—Miyata Zone (Yamagayado in Kami-Miyata), rare; Koshiba Zone (Koshiba), very frequent. Upper Musashino of Kazusa.

Family **Myochamidæ.**

Genus ***Myodora***, Gray.

180. **Myodora reeviana**, Smith.

Pl. XI. Figs. 12, 13.

Myodora reeviana. Pilsbry, New Jap. Mar. Moll., Pelecypoda, Proc, Acad. Nat. Sci. Philad. July, 1904, p. 558, pl. XLI, figs. 7, 8, 9. 10.

This species has been well described by Pilsbry in the above cited work. The shell is roughly pentagonal, with the right valve convex, and the left one flat and smaller.

We possess one right valve and one left valve. The former is from Koshiba and is 11,5 millim. long, 9 millim. high and 3 millim. deep. It has about seventeen regular concentric grooves on the surface. The latter is from Motowada, 6 millim. long and 5 millim. high, and its surface is more irregularly and shallowly grooved.

Myodora fluctuosa Gould which is so frequent in the Upper Musashino of Tokyo is distinguished from *Myodora reeviana* by having a more excavated antero-dorsal margin and only roughly undulated surface.

Fossil occurrence.—Miyata Zone (Motowada); Koshiba Zone (Koshiba). Upper Musashino of Kazusa and Shimosa.

Living.—Western Japan; China.

181. **Myodora triangularis**, A. Adams.

Pl. XI. Figs. 14, 15.

Myodora triangularis. Dunker, Index Moll. Mar. Jap., p. 181, pl. VII, figs. 11, 12.

The shell of this species is markedly triangular with the height slightly less than the length. The valves are both nearly flat, the left perhaps a little more so than the right. The surface is ornamented with coarse, rather regular, concentric grooves. The pallial sinus is small, but rounded and distinct.

We possess four left and three right valves. The largest (left valve) measures 11,5 millim. in length, 10,5 millim. in height and only 1,2 millim. in depth. The largest right valve measures 10 millim. in length and height, and 2 millim. in depth.

Fossil occurrence.—Naganuma Zone (Naganuma).

Living.—Japan (according to Dunker).

Family **Mytilidæ**.

Genus ***Mytilus***, Linne.

182. **Mytilus hirsutus**, Lamarck.

Pl. XI. Fig. 16.

Mytilus hirsutus. Lamarck, Anim. sans vert., vol. VII, p. 38. Reeve, Conch. Icon. Mytilus, pl. 3, fig. 8. Lischke, Jap. Meeresconch., I. p. 154. Dunker, Index Moll., p. 222.

The shell is ovately triangular, swollen, ornamented with a varying number of close longitudinal or radiating ribs. In our specimens which are all small, the lower or ventral margin is not concave as is usually the case, but straight or even slightly convex. The inner margin is finely crenulate as in the typical specimens. A right valve from Yokosuka measures 15 millim. in length, 10 millim. in height and 4 millim. in depth. Rare.

Fossil occurrence.—Miyata Zone (Kami-Miyata); Yokosuka Zone (Yokosuka).

Living.—Central and Western Japan.

183. Mytilus giganteus, Holmberg.

Pl. XI. Fig. 20.

Mytilus giganteus. Lischke, Jap. Meeresconch., I, p. 150.

Mytilus edulis forma gigantea. Alex. von Nordmann, Bull. Soc. Imp. des Naturalistes de Moscou, 1862, p. 422, pl. XI, XII.

The fragments of a large-shelled *Mytilus*, all belonging to the beak-portion. That these belong to *Mytilus giganteus* is shown by numerous small pits covering the whole inner surface of the shell. A species described as *Mytilus ungulatus* Lam. by Schrenck from Northern Japan may possibly be the same species, as already pointed out by Lischke.

Fossil occurrence.—Yokosuka Zone (Otsu).

Living.—Northern(?), Central and Western Japan. Also near Sitka in Alaska.

Genus *Modiola*, Lamarck.

184. Modiola modiolus, Linné.

Pl. XI. Fig. 21.

Modiola modiolus. Linné, Syst. Nat. ed 10, p. 706. Lischke, Jap. Meeresconch., I, p. 156, II, p. 147, III, p. 109. Dunker, Index Moll. Mar. Jap., p. 222. Tokunaga, Foss. Env. Tokyo, p. 63. Wood, Crag Moll., Bivalves, p. 57, pl. VIII, fig. 1. Nyst, Conch. Terr. Tert. Belgique, p. 163, pl. XVII, fig. 5.

Modiola grandis. Philippi, Enum. Moll. Sic., vol. II, p. 51, pl. 15, fig. 13.

Several large specimens measuring up to 95 millim. in length. Compared with recent forms from Hakodate, they are more parallel-sided in the posterior portion, and their posterior margin is a little more subtruncate, looking like a specimen represented in Reeve's work (Conch. Icon., *Modiola*, pl. I, fig. 2).

Fossil occurrence in Japan.—Miyata Zone (Matsubara in Shimo-Miyata). Upper Musashino of Kazusa.

Fossil occurrence in foreign countries.—Crag of England; Pliocene of Belgium and Italy.

Living.—Northern, Central and Western Japan; North Pacific; North Atlantic.

Family **Anomiidæ.**

Genus ***Anomia***, Linné.

185. **Anomia cytaeum**, Gray.

Pl. XI. Fig. 17.

Anomia cytaeum. Gray, Proc. Zool. Soc. London, 1849, p. 115. Reeve, Conch. Icon., vol. XI, *Anomia*, pl. II, fig. 10 ab. Schrenck, Nordjap. Moll., p. 473.

A few examples among which there is one with both valves complete. It is nearly orbicular in shape, strongly compressed, 22 millim. high and 24 millim. long. The surface is very uneven especially in the upper valve on which we see irregular wrinkles and tubercles in some places. The concentric lines of growth are undulating and sublamellar. The foramen is very large, oval, 9 millim. high and 6 millim. long. Compared with the living forms the hinge-line is more curved. The radiating ribs as shown in Reeve's figure are hardly to be seen, a character also observable in recent specimens from Hakodate.

Fossil occurrence.—Miyata Zone (Shimo-Miyata, Kami-Miyata and Motowada); Yokosuka Zone (Yokosuka and Otsu); Koshiba Zone (Koshiba); Naganuma Zone (Naganuma).

Living.—Northern and Central Japan; China (Mouth of the Yangtsekiang).

186. **Anomia nipponensis**, Yokoyama.

Pl. XI. Figs. 18, 19.

Several examples which, however, all belong to the upper valve.

The shell is thin to moderately thick, suborbicular to somewhat obliquely ovate in form. The upper valve is strongly convex with the surface radiately ribbed. The ribs are mostly close together and numerous, unequal, irregular, somewhat undulating and looking more like wrinkles than ribs, and often indistinct or obsolete near the beak. The incremental lines are numerous and distinct, and on crossing the ribs they make the latter appear often striated. In some specimens these lines of growth show a tendency to assume a sublamellated character.

Muscular impression distinct, white, more or less oval in form with the uppermost largest and sometimes appearing somewhat cordate in shape.

The largest specimen is 45 millim. high, 51 millim. long, 14 millim. deep and has a suborbicular form (see figure). Another one, which is ovate, measures 20 millim. in height and length and 13 millim. in depth (see figure).

This is a species which is still living in Japan, but apparently not yet named, It is very much like *Anomia laqueata* Reeve (Conch, Icon., Anomia pl. IV fig. 18 ab) which also lives in Japan. But in the latter, the beak is tumidly incurved, the ribs more regular, less in number and more distant.

Fossil occurrence,—Miyata Zone (Kami-Miyata, Shimo-Miyata and Motowada); Yokosuka Zone (Yokosuka and Otsu); Naganuma Zone (Naganuma). Upper Musashino of Shimosa.

Living.—Northern, Central and Western Japan.

Family **Limidæ**.

Genus ***Lima***, Bruguière.

176. **Lima goliath**, Sowerby.

Pl. XVI. Figs. 7, 8.

Lima goliath. Sowerby, Proc. Zool. Soc. London, 1883. p. 30. pl. VII, fig. 3.

This large species was found only in fragments. The shell is somewhat obliquely ovate in outline and rather flattened. The surface is ornamented with fine radiating and slightly undulating grooves which in the front portion of the shell become deep, so that the interspaces appear like ribs. In the middle of the shell surface, the grooves are generally shallow and faint.

Among the living shells from Sagami Bay there is a specimen attaining the height of 160 millim., compared with which the fossil forms are much smaller.

Fossil occurrence.—Miyata Zone (Yamagayado-no-Motofudoshita in Kami-Miyata); Koshiba Zone (Koshiba).

Living.—Central Japan (Sagami Bay at 400 fathoms); South-eastern Japan at 750 fathoms (Challenger); Patagonia.

188. **Lima zushiensis**, Yokoyama.

Pl. XII. Fig. 8.

This species is closely related to *Lima squamosa* Lam. (Lischke, Jap. Meeresconch., I, p. 162) living near our coast and also in the Indian and Atlantic oceans. In spite, however, of only a few, rather imperfect specimens which we possess, their difference is tolerably obvious. One of the fossil specimens measuring about 50 millim. in height possesses thirty-two ribs and another about 40 millim. in height twenty-seven ribs, so that the number of ribs is decidedly greater than in *Lima squamosa* Lam. which possesses only twenty to twenty-four. Indeed, in this respect, the fossil form comes between the Lamarckian species and *Lima multicostata* Sow. (Thes. Conch., I, p. 85, pl. XXII, fig. 38) of the Mediterranean, which latter has about thirty five ribs. Moreover, our fossil species, when compared with these living ones, has the ribs somewhat flatter and less distinctly scaly. But it must be confessed that there is a great possibility of the former being a mere variety either of the Lamarckian or of Sowerby species.

A full description of the species will be postponed until better specimens can be obtained.

Fossil occurrence.—Yokosuka Zone (Zushi).

189. **Lima angulata**, Sowerby.

Pl. XII. Fig. 12.

Lima angulata. Sowerby, Thes. Conch., vol. II, 86, pl. XXI, figs. 39, 40.
Lima lasilanica. Adams and Reeve, Voy. Samarang, Zoology, p. 75, pl. XXI, fig. 6.
Lima orientalis. Adams and Reeve, op. cit., p. 75, pl. XXII, fig. 7.
Lima halodatensis. Tokunaga, Foss. Env. Tokyo, p. 64, pl. III, fig. 26.

A single left valve, partly broken, thin and fragile, moderately swollen, obliquely oval in outline, obtusely subangulate at postero-ventral corner, with small, nearly equal ears. The surface

is ornamented with fine, radial, unequal striae crossed by dense concentric lines, thereby appearing somewhat scaly. The height may have been about 24 millim., and the length about 20 millim. The depth is 6 millim.

Fossil occurrence.—Naganuma, Zone (Naganuma); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern and Central Japan; Philippines; New South Wales; Panama; Bay of Caracas.

190. **Lima japonica**, A. Adams.

Pl. XII. Fig. 9.

Lima japonica. Reeve, Conch. Icon., vol. XIII, pl. V, fig. 21. A. Adams, Proc. Zool. Soc., 1683, p. 506.

Lima aff. japonica. Tokunaga, Foss. Env. Tokyo, p. 64, pl. III, fig. 26 ab.

Sowerby in Reeve's Conchologia Iconica describes this shell as follows:

„ Shell ovate, ventricose, broad, rather straight, nearly equilateral, rayed with numerous strong, rather sharp ribs; ventral margin scarcely obliquely produced; hinge margin broad; auricles nearly equal; umbones produced. "

We possess two valves which we identify with Adams species. The one is nearly perfect and larger, while the other is smaller and lacks the umbonal portion. The former measures 16 millim. in height, 10,5 millim. in length and 5 millim. in depth. It is thin and fragile, nearly elliptical in shape, almost equilateral and with both ears nearly equal. The surface-ribs are numerous, about twenty-six in number, straight, rather sharp and ridge-like toward the ventral margin, crossed by dense lines of growth. They are present all over the surface except at the farthest ends near the hinge-line. The ligamental pit is very broadly triangular and shallow. The smaller specimen measures 8 millim. in length and shows a somewhat less number of ribs.

Fossil occurrence.—Kanazawa Zone (Nojima); Koshiba Zone (Koshiba); Upper Musashino of Musashi.

Living.—Northern and Central Japan; New Zealand.

191. **Lima subauriculata,** (Montagu).

Pl. XII. Fig. 10.

Lima auriculata. Weinkauff, Conch. d. Mittelmeers, vol. II, p. 245. no. 7. Forbes and Hanley, Hist. of Brit. Moll., vol. II, p. 263, pl. LIII, fig. 4, 5. Reeve, Conch, Icon., vol. XVIII, *Lima*, pl. V, fig. 22. Wood, Crag Moll. pt. II, Bivalves, p. 47. pl. VII, fig. 3. Hörnes, Foss. Moll. Tertiär-Beckens von Wien, II, p. 389, pl. LIV, fig. 6. Nyst, Conch. Terr. Tert. Belgique, p. 158, pl. XII, fig. 3.

Lima sulcata. Möller, Ind. Moll. Groenl., p. 18.

Lima sulculus. Loven, index Moll. Scandin., p. 32, no. 2 244.

Lima nivea. Philippi, Enum. Moll. Sic., pt. I, p. 78 no. 3. Nyst, Rech. sur les Coq. Foss. Prov. d'Anvers, p. 17, no. 69.

Pecten subauriculatus. Montagu, Test. Brit., suppl., p. 65, pl. XXIX, fig. 2.

Two valves, one of which is broken. The perfect one is very small, 6 millim. high, 4 millim. long and 2 millim. deep, thin, fragile, oblong, tumid, equilateral and furnished with two equal ears. The surface is covered with straight, radiating, rather sharp riblets which are distinct only in the middle portion of the shell, and faint or obsolete on both sides. Their number is about sixteen. An interspace found in the middle of the shell is more conspicuous than others and probably corresponds to what Reeve designates as a median sulcus. Lines of growth numerous, distinct, giving a striated or granulated appearance to the riblets. Ligamental pit broadly triangular, with the apical angle slightly greater than a right angle.

This species is closely related to the preceding, but is smaller and lacks the riblets on the sides.

Fossil occurrence in Japan.—Miyata Zone (Shimo-Miyata and Kami-Miyata). Upper Musashino of Musashi, Shimosa and Kazusa.

Fossil occurrence in foreign countries.—Crag of England, Pliocene of Belgium and Italy, Miocene of France, Hungary, Austria, etc.

Living.—Mediterranean; Canaries; British Islands; Norway; Greenland.

192. **Lima quantoensis,** Yokoyama.

Pl. XII. Fig. 11.

Shell rather small, thin but firm, moderately convex, obliquely ovate, inequilateral, closed, with anterior auricle very small.

The antero-dorsal margin is somewhat excavated, while other margins are more or less rounded. The surface is ornamented with numerous, straight, round, radiating ribs separated by intervals of less breath. The number of ribs is about thirty-seven at the periphery, being replaced by a few striae on the posterior ear and on the lunula which is deep and short-lanceolate in form. Concentric lines of growth conspicuous, especially toward the ventral margin where the concentric grooves give the ribs a subscaly appearance. Area moderate in size, having the form of an inequilateral triangle, the anterior side being the shortest. Ligamental pit triangular, deep and with the apical angle acute. Inner margin crenate.

This species has a general outline of *Lima squamosa Lam.* (=*Lima lima* L.) but is thinner, more tumid and has a greater number of ribs, in which last respect it is not unlike *Lima multicostata* Sow., a species which is flatter.

A few specimens; the perfect one, a right valve, is represented in our figure. It is 22 millim. high, 18 millim. long and 6 millim. deep.

Fossil occurrence.—Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living.—A worn specimen strongly resembling this fossil species has been obtained near the coast of Awa (Central Japan).

Family **Pectinidæ.**

Genus ***Pecten***, Belon.

193. Pecten squamatus, (Gmelin).

Pl. XIV, Fig. 3, 4.

Pecten squamatus. Sowerby, Thes. Conch., I, Pecten p. 70, pl. III, fig 57, 58. Reeve, Conch. Icon., vol. VIII, sp. 82. Dunker Index Moll. Mar Jap., p. 240, pl, XI, fig. 14. Küster in Syst. Conch., Cab., VII, pt. II, Spondylus und Pecten, p. 113, pl. XXXII, fig. 4. Yoshiwara, Nihon San Kairui Zusetu, Pectinidae, Zool. Mag. Tokyo, Vol. XIV, p. 208, pl. III, fig. 8. Lischke, Jap. Meersconchyl., II, p. 173.

Ostrea squamata. Gmelin, Syst. Nat. ed. 13, p. 3329.

One left and two right valves, the former lacking the beak-portion and the latter especially the anterior ear. They are very

little convex, the right valves being nearly flat. The left valve is 27 millim. long and possesses twenty-one radiating ribs, of which about six larger ones are scaly. The interspaces between the ribs are finely reticulate, a character also seen in our living specimens. The right valves are strongly water-worn The larger is 31 millim. long and 34 millim. high, while the smaller is 24 millim. long and 25 millim. high. The ribs in the former number twenty-four, while in the latter twenty. They are unequal and at unequal distances from one another, and also devoid of scales by rubbing. The posterior ear is small, triangular and radially sculptured either by riblets or striæ.

Fossil occurrence.—Naganuma Zone (Naganuma),

Living.—Central Japan; Philippines.

194. Pecten laetus, Gould.

Pl. XIV. Figs. 1, 2.

Pecten laetus. Gould, Otia Conch., p. 177. Lischke, Jap. Meeresconch., I, p. 169, pl. XII, figs. 6, 7, II, p. 157. Dunker, Index Moll., p. 241. Schrenck, Nordjap. Moll., p. 603. Brauns, Geol. Env. Tokio, p. 57. Tokunaga, Foss. Envir. Tokyo, p. 65, pl. V, fig. 2, Yoshiwara, Nihon San Kairui Zusetsu, Zool. Mag. Tokyo, vol. XIV, p. 143, pl. II, fig. 1. Küster in Syst. Conch. Cab., VII, pt. II, p. 134, pl. XXXVII, figs. 4, 5.

Several specimens of Gould species were obtained, though none with both valves complete. This species resembles the preceding in many respects, but is generally distinguished by somewhat more convex valves and a greater number of ribs. *Pecten islandicus* Müller, living in Northern Japan is also not unlike *Pecten laetus*, but it has more ribs than the latter which are also less scaly.

The unequality of ribs in *Pecten laetus*, is especially conspicuous on the left valve, the larger ones among them showing rough and high erect scales which may be many or few and are generally at unequal distances from one another. The largest of our specimens is a left valve measuring 56 millim. in length, 54 millim. in height and 10 millim. in depth.

Fossil occurrence:—Miyata Zone (Kami-Miyata and Shimo-

Miyata); Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma); Upper Musashino of Musashi and Kazusa.

Living:—Northern, Central and Western Japan.

195. Pecten crassicostatus, Sowerby.

Pl. XII. Fig. 7.

Pecten crassicostatus. Sowerby, Thes. Conch., I, p. 75, pl. XV, fig. 111, XVII. fig. 152. Reeve, Conch. Icon., vol. VIII, Pecten, No. 64, pl. 48, fig. 64. Küster in Syst. Conch. Cab., vol. VII, pt. II, p. 104, pl. 29, figs. 2 5. Dunker, Ind. Moll., p. 239, pl. XIII, fig. 28. Yoshiwara, Nihon San Kairui Zusetsu, Zool. Mag. Tokyo, vol. XIV, p. 142, pl. I, fig. 3.

A single fragment of a right valve belonging to the portion containing the anterior ear. It is readily distinguishable by numerous equal radiating ribs which are closely scaly.

Fossil occurrence:—Naganuma Zone (Naganuma).

Living:—Central and Western Japan; Shanghai, Hongkong.

196. Pecten irregularis, Sowerby.

Pl. XIII. Figs. 1–3.

Pecten irregularis. Sowerby, Thes. Conch., vol. I, p. 69, pl. XIII, figs. 51, 52. Lischke, Jap. Meeresconch., vol. I, p. 170. Dunker, Index Moll., p. 240, pl. XI, figs. 2, 15. Yoshiwara, Nihon San Kairui Zusetsu, Zool. Mag. Tokyo, vol. XIV, p. 210, pl. IV, fig. 12. Yokoyama, Pectens from the Koshiba Neogene, Journ. Geol. Soc. Tokyo, vol. XVIII, no. 208, p. 2, pl. I. figs. 5–7.

This small-sized *Pecten* is ovate in form, subequivalve, rather flattened, with the left valve flatter than the right, almost equilateral and ornamented with about twenty-five subangular, scaly, subequal, radiating ribs generally separated by intervals of a greater breadth. The ribs are seen occasionally dividing into two or three towards the ventral margin. The ears are very unequal, the anterior being the largest; they are also furnished with scaly radial riblets.

Frequent at Koshiba, though rare at other places.

The largest specimen of a right valve measures 21 millim. in height, 19 millim. in length, and 4 millim. in depth.

Fossil occurrence:—Miyata Zone (Harashita in Shimo-Miya-

ta); Yokosuka Zone (Yokosuka); Koshiba Zone (Koshiba); Upper Musashino of Kazusa.

Living:—Central and Western Japan; East Indies.

197. Pecten vesiculosus, Dunker.

Pl. XIII. Figs. 11–13.

Pecten vesiculosus. Dunker, Index Moll., p. 241, pl. XI, fig. 1. Küster in Syst. Conch. Cab., vol. VII, pt. 2, p. 138, pl. XXXVIII, fig. 4. Yoshiwara, Nihon San Kairui Zusetsu, Zool. Mag. Tokyo, vol. XIV, p. 212, pl. IV, fig. 16. Yokoyama, Pectens from the Koshiba Neogene, Jour. Geol. Soc. Tokyo, vol. XVIII, no. 208, 1911, p. 1. pl. I, figs. 8–10.

The shell is rather small, firm, roundly ovate, slightly inequivalve, the left valve being a little oblique, and moderately convex, the convexity of the two valves being nearly equal. The surface is furnished with about sixteen equal, rounded, smooth or transversely striated, radiating ribs which are accompanied on both sides and close to their base by a small riblet. The interspaces between the ribs are about as wide as the latter, and ornamented with fine longitudinal lines crossed by fine transverse ridges which also continue to the flanks of the ribs. Ears unequal, ribbed, with ribs rough and subscaly. Byssal notch distinct.

Many specimens, the largest valve (right) in our collection measuring 26,5 millim. in height, 26 millim. in length and 6 millim. in depth.

Fossil occurrence:—Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living:—Central Japan.

198. Pecten swiftii, Bernardi.

Pl. XIV. Fig. 11.

Pecten swiftii. Bernardi in Journ. de Conchyl,, VII, 1858, p. 90, pl. I, pl. II, fig. 1. Schrenck, Nordjap. Moll., p. 487, pl. XXI, figs. 1 3. Dunker, Index Moll. Mar. Jap., p. 242. Küster in Syst. Conch. Cab., vol. VII, pt. II, p. 142, pl. 40, fig. 3. Yoshiwara, Nihon San Kaisui Zusetsu, Zool. Mag. Tokyo, vol. XIV, p. 144, pl. II, fig. 3.

A single right valve of a young shell, 21,5 millim. in height and 18,5 millim. in length. It is only little convex, ovate in

form and furnished with five coarse, broad, flattish, radial ribs which are again divided into a few (generally four) unequal riblets. The interspaces are somewhat narrower than the ribs and are also furnished with several riblets which are finer than those on the ribs. The ears are broken,

On comparing our specimen with the living ones, it agrees with the above named species in general, but with this difference that the riblets on the ribs are larger than those of the interspaces while in the living forms they are nearly equal.

Fossil occurrence:—Koshiba Zone (Koshiba).

Living:—Northern Japan; Sea of Ochotsk; Alaska.

199. Pecten tigerrinus, Müller.

Pl. XIV. Figs. 5, 6.

Pecten tigerrinus, Müller, Zool. Dan. Prod., I, p. 248, No. 2993. Nyst, Descr. d. Coq. et Polyp. Fossil. Tert. de Belg., p. 303, pl. XXIII, figs. 4–10. Conch. d. Terr. Tert. de la Belgique, pt. I, p. 152, pl. XV, figs. 4. Yokoyama, Pectens from the Koshiba Neogene, Jour. Geol. Soc. Tokyo, vol. XVIII, No. 208, p. 3, pl. I, figs. 11–12.

Pecten tigrinus. Wood, Crag Moll., Bivalves, p. 27, pl. V, figs. 2. Lovén, Ind. Moll. Scand., p. 31. Forbes and Hanley, Hist. Brit. Moll., vol. II, p. 285, pl. I, figs. 8–11. Reeve, Conch. Icon. pl. XXVIII, fig. 122.

Pecten obsoletus. Sowerby. Min. Conch., VI, p. 79, pl. DXLI, figs. 1–8.

There are two valves, a left and a right, of which the former measures 32 millim. in height, 30 millim. in length and about 8 millim. in depth, while the latter is much smaller, being 20 millim. in height, 18 millim. in length and about 4,5 millim. in depth. Both are somewhat convex, roundly ovate in form, nearly equilateral and provided with numerous, very unequal, rounded, radial ribs of which about five are especially large. Of these five, the one situated near the middle of the shell is the largest. The inside of the shell are also radiately ribbed, the ribs and their interspaces corresponding respectively to the interspaces and ribs of the outer surface. The left valve is furnished with a broad concentric constriction at about one-fourth the height from the ventral margin. The inner margin is irregularly wavy. The ears are unqual.

Pecten tigerrinus is a very variable species, the shell being

sometimes quite smooth and sometimes coarsely ribbed. Our specimens seem to correspond to the variety *gamma* (fig. e and f) of Wood, though not so orbicular in shape.

Fossil occurrence in Japan.—Koshiba Zone (Koshiba).

Fossil occurrence in Foreign countries.—English Crag from the Coralline to the Chiliesford beds; Scaldisien of Belgium; Pliocene of Italy.

Living.—Brittany; North Sea; Norway,

200. Pecten cosibensis, Yokoyama.

Pl. XIII. Figs. 7, 8.

Pecten cosi'ensis. Pectens from the Koshiba Neogene, Jour. Geol. Soc. Tokyo, vol. XVIII, No. 208, p. 4, pl. I, figs. 3, 4.

Several specimens which, however, are more or less broken.

The shell is rather thin though firm, ovately rounded, inequivalve, nearly equilateral, radiately ribbed and provided with unequal ears. The right valve is very convex, while the left is nearly flat. The ribs are rounded and very unequal, the larger ones being generally in twos, rarely in threes and dividing themselves into two or sometimes even into three in the lower half of the shell. The valleys between the larger ribs are deep, broad or narrow and also ornamented with a few radial riblets. Concentric constrictions are present in larger specimens which are not many and at unequal distances from one another, The anterior ear is the largest with interrupted radial ribs; the posterior is very small.

The largest specimen is that of a right valve, 56 millim. in height and length, and 12 millim. in depth.

Fossil occurrence.—Koshiba Zone (Koshiba).

201. Pecten intuscostatus, Yokoyama.

Pl. XIII. Figs. 9. 10.

Shell small, thin, compressed, nearly equivalve, equilateral, nearly round, with antero-dorsal and postero-dorsal margins sloping, straight or slightly concave and forming obtuse angles at

anterior and posterior ends. Surface with fine dense concentric lines. Inner surface with about sixteen distant radial riblets, most distinct near the ventral margin, at a little distance from which they are somewhat thicker and knot-like. Ears very unequal, the anterior being the largest; they are also unequal in both valves, those of the right being much larger than those of the left. They are all ornamented with radial scaly riblets, except the posterior ear of the left valve, which is very small and smooth. Byssal notch distinct.

A perfect specimen with both valves from Kami-Miyata measures 11 millim. in length and height, and 3 millim. in thickness.

A single valve (right?) from Koshiba which I described as *Pecten similis* Lasky (Proc. Geol. Soc. Tokyo, vol. XXVIII, no. 208, p. 3, pl. I, fig. 1) is, as I am now convinced, an imperfectly preserved specimen of this species.

A young specimen of the left valve from Shimo-Miyata, only 5,5 millim. high does not show the radial riblets of the inner surface.

This species resembles *Pecten distinctus* Smith (Challenger Lamellibr., p. 304, pl. XXII, fig. 3) in form, but the latter has the radiating striae on the surface, while the internal costulae are wanting.

Fossil occurrence.—Miyata Zone (Shimo-Miyata and Kami-Miyata); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

202. Pecten miurensis, Yokoyama.

Pl. XII. Figs. 2–6.

Shell large, rather solid, compressed, inequivalve, the right valve more convex than the very flattened left valve, nearly equilateral, roundly ovate in form, somewhat higher than long. Surface with about twenty-five smooth, rounded, radiating ribs separated by intervals of about an equal breadth in which there is a single interstitial riblet with traces of distant scales. Ears unequal, the anterior being the largest, both ornamented with granular radial riblets.

There are several specimens of this species, but the preservation is bad, though sufficient to show that they belong to a still undescribed species. The largest right valve measures about 130 millim. in height. One of the right valves, comparatively well preserved, is about 85 millim. high, 75 millim. long and 8–9 millim. in depth.

Rather frequent at Zushi.

Fossil occurrence.—Miyata Zone (Harashita in Shimo-Miyata); Yokosuka Zone (Zushi),

203. **Pecten tokunagai,** Yokoyama.

Pl. XII. Fig. 1.

Pecten tokunagai. Yokoyama, Pectens from the Koshiba Neogene, Jour. Geol. Soc. Tokyo, vol. XXVIII, no. 208, p. 4. pl. I, fig. 2.

Only a single valve (right?) partly broken, and about 68 millim. in height. It is thin, orbicular, moderately convex (about 12 millim. deep) and furnished with about thirty-three simple, flatly rounded, subequal, straight, radiating ribs which are indistinct near the beak. The interspaces are much broader than the ribs themselves, finely reticulate, and occasionally with a secondary riblet which vanishes much more quickly than the main ribs towards the beak. The ears are nearly equal and ornamented with flat perpendicular riblets which together with the interspaces are again perpendicularly striate.

Fossil occurrence.—Koshiba Zone (Koshiba).

204. **Pecten tokyoensis,** Tokunaga.

Pl. XIV. Figs. 7, 8.

Pecten tokyoensis, Tokunaga, Foss. Env. Tokyo, p. 65, pl. V, figs. 1–10.
Pecten plica. Brauns, Geol. Env. Tokio, p. 48.

A large inequivalved *Pecten* mistaken by Brauns for *Pecten plica* L. was fully described by Tokunaga in the above cited work. The right valve of this shell which is tolerably convex shows a few broad flattened ribs often divided into several indistinct riblets and separated by mostly shallow, and narrower interspaces. The

left valve which is quite flat has a few low but sharp-ridged ribs. Very frequent, especially in the Miyata and Naganuma Zones.

Fossil occurrences.—Miyata Zone (Imori or Kutsukata in Shimo-Miyata, Komatsugaike in Kami-Miyata and Motowada); Yokosuka Zone (Otsu and Yokosuka); Naganuma Zone (Naganuma); Upper Musashino of Musashi, Shimosa and Kazusa.

205. **Pecten yessoensis**, Jay.

Pl. XIII. Figs. 14, 15.

Pecten yessoensis. Jay, Rep. on Shells coll. by Japan Exped., in Perry's Narrat. of Exped. of Americ. Squadr. to China Seas and Japan, vol. VII, p. 293, pl. III, figs. 3, 4, pl. IV, figs. 1, 2. Schrenck, Moll. d. Amurl. u. d. Nordjap. Meeres, p. 484, pl. XX, figs. 1–4. Lischke, Jap. Meeresconch., I, p. 165, pl. X, figs. 3, 4, II, pl. XIII. Dunker, Index Moll., p. 240. Brauns, Geol. Env. Tokyo, p. 48. Yokoyama, Pectens from the Koshiba Neogene, Jour. Geol. Soc. Tokyo, vol. XXVIII, no. 208, p. 2, pl. I, figs. 13, 14.

Mostly in imperfect specimens.

A recent shell which we got from the Hokkaido, 115 millim. in height, is orbicular, inequilateral and radiately ribbed. The right valve is tolerably convex with somewhat unequal ears, while the left valve is nearly flat with ears equal. The ribs on the right valve are about twenty-two, broad and flattish, subequal, broader than the interspaces, now and then divided into equal or unequal halves by a longitudinal groove. Those on the left valve are somewhat more in number, also flattish towards the ventral margin, but generally narrower than the interspaces.

The fossil forms are all smaller than the above-described recent one, so that the ribs number only between seventeen and twenty-two.

Fossil occurrence:—Miyata Zone (Shimo-Miyata); Kamakura Zone (Kewaizaka in Kamakura); Kanazawa Zone (Kanazawa); Koshiba Zone (Koshiba); Upper Musashino of Musashi.

Living:—Northern Japan; Ochotsk Sea.

206. Pecten laqueatus, Sowerby.

Pl. XIV. Figs. 9, 10.

Pecten laqueatus. Sowerby, Thes. Conch., vol. I p. 46, pl. XV, fig. 101. Lischke, Jap. Meeresconch., I, p, 167, II, p. 157, pl. XII, fig. 1, 2. Schrenck, Moll. d. Amurl. u, d. nordjap. Meeres, p. 482. Küster in Syst. Conch. Cab., vol. VII, pt. 2, p. 79, pl. XX, fig. 5, p. 137, pl. XXXVIII, fig. 1. Brauns, Geol. Env. Tokio, p. 48. Tokunaga, Foss.-Env. Tokyo, p. 64.

Vola laqueata. Dunker, Index Moll., p. 243. Pilsbry, Cat. Mar. Moll. Jap., p. 143.

Pecten antonii. Philippi, Abbild. u. Beschr., vol. I, p. 99, Pecten, pl. I, fig. 1.

Specimens of this species are not numerous, but easily recognized by their peculiar characters. The right valve is very convex with broad, flat, radiating ribs, whose number is normally eight, with one or two, rarely three, narrow secondary ribs on both sides of the shell. The left valve is slightly concave with narrower, flatly rounded radiating ribs whose normal number is seven or eight. The ears are nearly equal, with a shallow notch below the anterior one.

Fossil occurrence:—Miyata Zone (Shimo-Miyata and Kami-Miyata); Yokosuka Zone (Otsu); Upper Musashino of Oji and Shinagawa.

Living:—Northern, Central and Western Japan.

207. Pecten naganumana, Yokoyama.

Pl. XIII. Figs. 4–5.

Shell medium-sized, not very thick but firm, roundish, broader than high, strongly inequivalve, nearly equilateral, the lower margin describing a semicircle with the anterior and posterior corners obtusely angulate and the antero-dorsal and postero-dorsal margins sloping and somewhat concave. Right valve convex and swollen, with broad and flatly rounded, subequal, radiating ribs separated by intervals of a less breadth; number of ribs normally twelve, but sometimes thirteen or eleven with one to three small subsidiary riblets at the anterior as well as at the posterior ends. Left valve quite flat, or even a little concave, also ornamented with flatly rounded radiating ribs which, however, are much narrower than those of the right valve, so that the interspaces become consequently wider than the ribs; their

number is normally eleven, but may lessen to ten or increase to twelve and may also be accompanied by a few subsidiary riblets at both ends of the valve. Fine dense concentric elevated lines cross the ribs as well as the interspaces, most distinct on the flat valve, often obsolete on the ribs of the convex valve, on which we often observe several longitudinal striae. Ears are nearly equal especially on the flat valve, the anterior ear of the right valve being marked by a shallow byssal notch.

The largest specimen in our possession measures 82 millim. in height, 95 millim. in length and 25 millim. in depth.

This species is very close to the preceding one in the form of the shell, but is at once recognized by the number of ribs. In *Pecten laqueatus* the normal number of the ribs of the convex valve is eight, which may rarely increase to nine, with or without some subsidiary riblets at both extremities of the shell. Sometimes one or two ribs may be split into two by a median groove, but this groove never attains such a breadth as to make them appear as two separate ones. The left valve has also only eight or nine ribs. Still it may not be impossible that the intermediate forms occur, but so far as my present investigation goes, both on the numerous fossil as well as on recent shells, I have not been able to discover any.

Pecten fumatus Reeve (=*Pecten bifidus* Menke, Philippi, Abbild., vol. I, Pecten, pl. II, fig. 6 and Syst. Conch. Cab., vol. 7, Pecten, p. 160, pl. 45, figs. 1, 2) from Australia (near Sydney) is also closely related to our fossil, though the beak of the right valve is a little more swollen and the ribs are somewhat wider in the Australian shell.

Very frequent. Some of the specimens show traces of an orange-red colour.

Fossil occurrence:—Naganuma Zone (Naganuma).

Family **Ostreidæ.**

Genus ***Ostrea***, Linné.

208. **Ostrea gigas**, Thunberg.

Pl. XV. Figs. 1, 2.

Ostrea gigas. Thunberg, Kongl. Vetenkaps Akad. nya Handl., Tom. XIV, 1793, p. 140, pl. VI, figs. 1–3. Lischke, Jap. Meeresconch., vol. I, p. 174, III, p. 114. Dunker, Index Moll., p. 249. Brauns, Geol. Env. Tokio, p. 48, 51, 55. Tokunaga, Foss. Env. Tokyo, p. 68, pl. I V, fig. 5.

Ostrea laperousii. Schrenck, Moll. Amurl. u. d. nordjap. Meeres, p. 475, pl. XIX.

Ostrea talienwhanensis. Crosse, Jour. Conchyl., vol. X (3d series, vol. II), p. 149, pl. VI, fig. 6.

A few typical ovate as well as elongated forms which undoubtedly belong to a species of *Ostrea* most widely distributed in Japan and everywhere used as food.

Fossil occurrence.—Yokosuka Zone (Yokosuka and Otsu); Koshiba Zone (Koshiba); Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern, Central and Western Japan; Strait of Tartary; Coast of Manchuria and Shantung in China.

209. **Ostrea denselamellosa**, Lischke.

Pl. XVI. Fig. 6.

Ostrea denselamellosa. Lischke, Jap. Meeres conch., I, p. 79, pl. XIII, pl. IV, fig. 1. Brauns, Geol. Env. Tokio, p. 58. Tokunaga, Foss. Env. Tokyo, p. 65, pl. IV, fig. 6.

A single valve, somewhat broken at the posterior margin, thick, longly ovate in form, about 95 millim. in height, slightly convex and ornamented with numerous radial, lamellated folds which, however, have been much obliterated by friction. Comparing it with the living specimens of *Ostrea denselamellosa*, it agrees quite well in its general characters.

Fossil occurrence.—Yokosuka Zone (Otsu); Upper Musashino of Musashi and Shimosa.

Living:—Central and Western Japan; also Ryukyu Islands (according to Pilsbry).

210. Ostrea plicata, Chemnitz.

Pl. XVII. Figs. 1, 2, 3.

Ostrea plicata. Chemnitz, Conch. Cab. VIII. p. 34, pl. 73, fig. 674, pl. 74, fig. 680. Reeve, Conch. Icon, vol. XII, Ostrea, no. 63, pl. XXVII, fig. 63. Dunker, Index Moll., p. 249.

Several ill preserved specimens. The upper as well as the lower valve is depressed and only a little convex. The general shape is ovate to oblong. The shell is either solid or rather thin. On the surface there are generally a few radial folds most distinct near the margin. On both sides of the hinge, the inner margin is generally crenate or crenulate. The largest specimen which we have is only 65 millim. high.

Fssil occurrence.—Yokosuka Zone (Otsu).

Living.—Western Japan; China and East Indies.

211. Ostrea musashiana, Yokoyama.

Pl. XVI. Figs. 1–5.

Shell moderate-sized, rather thin, generally ovate in outline, but sometimes oval to oblong. Lower valve very convex with the surface smooth and uneven, and marked with concentric valleys and lines, the latter sometimes elevating themselves into short laminae. In some specimens are developed a few radial plaits which are, however, irregular and mostly indistinct. Left valve unevenly flat. Frequent.

The largest specimen measures a little over 60 millim. in height.

Fossil occurrence.—Yokosuka. Zone (Yokosuka); Koshiba Zone (Koshiba). Upper Musashino of Shimosa.

Family Arcidæ.

Genus *Arca*, Lamarck.

212. Arca kobeltiana, Pilsbry.

Pl. XVII. Fig. 4.

Arca kobeltiana. Pilsbry, New Jap. Mar. Moll., Pelecypoda, Proc. Acad. Nat. Sci. Philadelphia, july, 1904, p. 559, pl. XL, figs. 16–19.

Arca ocellata. Kobelt in Syst. Conch. Cab. Mart. u. Chemn., vol. VIII, p. 87, pl. 24, figs. 1–4, (non Reeve). Pilsbry Cat. Mer. Moll. Jap., p. 148.

Arca rectangularis. Tokunaga, Foss. Env. Tokyo, p. 61, pl. III, fig. 23.

The shell is generally transversely quadrate, very convex with the posterior margin obliquely truncate, so that it makes a blunt angle with the straight or even concave ventral margin. A sharp keel runs from the beak to the postero-ventral corner. The surface-sculpture consists of numerous granulated, subequal, radiating ribs which on the posterior side become larger and often double and are separated by wide interspaces with a few (generally two) small riblets. The surface is more or less uneven, so that the ribs are also somewhat undulating.

Pilsbry lays great stress on the character of the area as a distinction from Reeve's *Arca ocellata*, and speaking of his *Arca kobeltiana*, he says.

,, The wide ligamental area is marked off into concentric lozenges by very numerous ligament-filled, diagonal, broadly v-shaped sulci, of which I count 11 in a shell 44 millim. long, 17 in one 55 millim. long. The hinge-line is narrow, the teeth fine, close and vertical in the middle, somewhat irregular there and anteriorly, but posteriorly they become coarse and very oblique and strongly crenulate on the upper edges..... Having before me a topotype of *Arca ocellata* Rve as well as several Japanese specimens which agree with them, I am compelled te regard the two species as entirely distinict, and not even closely related, although they agree in general shape. The ligamental area in *A. ocellata* is smooth, scored by only a few, usually imperfect ligament-grooves, there being a large oblique triangle posteriorly and an erect triangle between the beaks free from them. The two oblique triangles marked by grooves are usually covered with a smooth yellow (or in some Japanese shells, blackish) cuticle, while the rest of the area is whitish. This is well shown in the dorsal aspect of a specimen of *A. ocellata* from the province of Suruga drawn in fig. 21 of pl. XLI.''

In fact all of our fossil specimens have lozenge-shaped grooves crossed by lines parallel to the hinge-line, whose number varies

according to the size of the shell. In a specimen about 20 millim. long we count five, but there is one only 35 millim. long and with more than ten grooves. The posterior portion of the area is free from grooves, ornamented only with straight lines parallel to the hinge-line. There is a considerable variation in the form of the shell. Rather frequent.

The largest specimen in our possession is a left valve 47 millim. long, 27 millim. high and 13 millim. deep.

Fossil occurrence.—Miyata Zone (Motoyashiki in Shimo-Miyata); Yokosuka Zone (Yokosuka and Otsu); Kanazawa Zone (Nojima); Koshiba Zone (Koshiba). Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Northern and Central Japan.

213. **Arca decussata,** (Sowerby).

Pl. XVII. Fig. 5.

Arca decussata. Reeve, Conch. Icon., Arca, sp. 81, pl. XII, fig. 81. Lischke, Jap. Meeresconch., I, p. 149. Syst. Conch. Cab., vol. VIII, p. 144, pl. 37, figs. 2–5.

Byssoarca decussata. Sowerby, Proc. Zool. Soc. London, 1833, p. 22.

Barbatia decussata, Dunker, Index Moll., p. 232.

A young right valve, 14 millim. long, 9 millim. high and 3,5 millim. deep.

It is transversely oval, very inequilateral, dorsally somewhat excavated in the middle, with numerous unequal, radiating riblets crossed by concentric lines, some of which are rather coarse. There is no sharp diagonal keel on the surface. The area is rather narrow, with grooves parallel to the hinge-line. The shell is rather worn and thin, but it seems to have been originally firm. It agrees very well with the living specimens of the species named.

Fossil occurrence.—Koshiba Zone (Koshiba).

Living.—Western Japan; Philippines; South Sea; Indian Ocean; Gulf of Guinea.

214 **Arca stearnsii,** Pilsbry.

Pl. XVI. Fig. 9.

Arca stearnsii. Pilsbry, Cat. Mar. Moll. Japan, p. 148, pl. III, figs. 8–10.

A water-worn right valve, 9 millim. long, 5 millim. high and 2,5 millim. deep. It is dorsally depressed, a character not found in the form described by Pilsbry. But its subtrapezoidal shape and other characters leave no doubt of its being the same species.

Fossil occurrence:—Koshiba Zone (Koshiba).

Living:—Central Japan.

215. Arca symmetrica, Reeve.

Pl. XVII. Figs. 7, 8.

Arca symmetrica. Reeve, Conch. Icon., Arca, sp. 117, Syst. Conch. Cab. Mart. Chemn., vol. VIII, p. 94, pl. 25, figs. 7, 8.

The shell is small, solid, generally quadrate in outline, swollen, closed, equivalve, somewhat inequilateral, with a sharp keel running from beak to postero-ventral corner. The surface is ornamented with numerous radiating riblets which are more or less granulated.

The shape is very variable. The normal forms have the upper and lower margins parallel, but these are those which show the height in the posterior portion less than in the anterior, a character which is especially eminent in our fossil and which makes the postero-ventral corner as if somewhat rostrated, In specimens of this kind, the median dorsal depression is pushed more to the posterior side, and anterior margin is more rounded than in the typical ones. The thickness of the shell is also variable. In recent forms which we have, it is either equal to, or greater than, the height, while in the fossil, it is either equal or less.

Rather frequent. The largest fossil specimen measures 18 millim. in length and 12,5 millim. in height and thickness.

Fossil occurrence.—Yokosuka Zone (Yokosuka); Naganuma Zone (Naganuma). Upper Musashino of Shimosa.

Living.—Central and Western Japan; Philippines; Indian Ocean.

216. Arca inflata, Reeve.

Pl. XVII. Fig. 9.

Arca inflata. Reeve, Conch. Icon., Arca sp. 30, pl. V, fig. 30. Kobelt in Syst. Conch. Cab., vol. VIII, p. 30, pl. 10, figs. 1, 2. Lischke, Jap. Meeresconch., I, p. 146. Brauns, Geol. Env. Tokio p. 44. Tokunaga, Foss. Env. Tokyo, p. 57, pl. III, fig. 19.

Arca broughtonii. Schrenck, Moll. Amurl. u. d. Nordjap. Meeres, p. 578, pl. 24, figs. 1–3.

Arca tenuis. Tokunaga, Foss. Env. Tokyo, p. 58, pl. IV, fig. 1.

A large specimen, 110 millim. long, 85 millim. high and 77 millim. thick, with forty-two ribs and a moderate-sized area. According to Yamakawa (Jour. Geol. Soc. Tokyo, vol. XVIII, no. 209, *Scapharca*) this species is distinguished from *Arca satowi* Dunker (Index Moll., p. 233, pl. 9, figs. 1–3) to which it is closely allied by the following characters:

1. Antero-dorsal angle is nearly a right angle (decidedly obtuse in *Arca satowi*).

2. Hinge-line is longer in comparison to shell-length than in *Arca satowi.*

3. Number of ribs is thirty-eight to forty (thirty-five to thirty-nine in *Arca satowi*).

4. Beaks less prominent.

5. Beaks medially more deeply furrowed than in *Arca satowi.*

6. Height, when compared to length, is less than in *Arca satowi.*

Fossil occurrence.—Naganuma Zone (Naganuma); Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Northern, Central and Western Japan; Philippines.

Genus *Pectunculus.* Lamarck.

217. Pectunculus rotundus, Dunker.

Pl. XVII. Figs. 10, 11.

Pectunculus rotundus. Dunker, Index Moll. Mar. Jap., p. 236, pl. XVI, figs. 9, 10. Pilsbry, Cat. Mar. Moll. Jap., p. 150.

Several specimens of a rotund *Pectunculus* flatly convex and mostly small (below 25 millim. in diameter) in form. Dunker in describing this species had a specimen only 22 millim. in diameter.

We possess a right valve which is considerably larger—36 millim. in diameter—than the specimen figured by Dunker. It is also thicker and deeper (6 millim. in depth) and may represent a full grown form of the same spicies.

Fossil occnrrence,—Miyata Zone (Matsubara and Iwaiguchi in Kami-Miyata); Naganuma Zone (Naganuma). Upper Musashino of Shimosa.

Living.—Central Japan.

218. **Pectunculus yessoensis**, Sowerby.

Pl. XVIII. Figs. 1, 2.

Pectunculus yessoensis. Sowerby, Description of Fourteen New Shells from China, Japan and the Andaman Islands, Proc. Zool. Soc. London, 1886. p. 570, pl. XXVIII, fig. 19. Pilsbry, Cat. Mar. Moll. Jap., p. 150.

This species is characterized by the marked posterior angle which is, however, not so distinct in young specimens. The surface shows fine decussate lines. Four left valves which we possess are all not full grown. A specimen from Motowada 33 millim. high, 36,5 millim. long and 8 millim. deep has the posterior angle rather obscure, while the one from Okine, which is somewhat smaller (30 by 32), is deeper (9 millim,) with the posterior angle more distinct and the hinge line somewhat more bent.

Fossil occurrence.—Miyata Zone (Motowada and Okine). Upper Musashino of Shimosa and Kazusa.

Living.—Northern Japan (Bay of Hakodate).

219. **Pectunculus nipponicus**, Yokoyama.

Pl. XVIII. Figs. 3–6, 7 (?).

Shell rather small, solid, moderately convex, oblique, ovately rounded, inequilateral, anterior side shorter and its margin rounded, posterior side somewhat produced and either rounded or forming a rounded angle at the place where the obliquely descending postero-dorsal margin meets with the ascending postero-ventral margin, ventral margin arcuate. Surface with numerous radiating

impressed lines crossed by concentric lines of growth, with the points of intersection sometimes looking like minute pits. Inner surface smooth, with only irregular radiating lines most distinct towards the margin which is finely crenulate. Beaks small but pointed. not touching. Area distinct, but comparatively small, broadly triangular in shape, with a few elevated straight parallel ridges which diverge from the median line. Hinge-teeth numerous, vertical in the middle, oblique towards the sides, lamellar, straight or curved or rarely knie-shaped. Muscular impressions distinct, the posterior one bounded within by an elevated ridge which becomes weaker towards the beak.

The form of the shell is very variable, some being more rounded than others, but invariably more or less ovate and oblique when compared with most of the species of this genus. The majority of the specimens have the length slightly greater than the height, but there are some in which they are nearly equal, while in a few instances, the height is greater than the length. The specimen shown in fig. 7 is probably an abnormal form of the same species markedly ovate and more convex than others.

The largest specimen which is a right valve measures 30 millim. in length and height and 9 millim. in depth. Another specimen which is also a right valve measures 29,5 millim. in length, 28 millim. in height and 7,5 millim. in depth,

On the outer surface of some specimens we observe purplish traces of an original colouring. This species is not unlike *Pectunculus mundus* Sowerby (Ann. Mag. Nat. Hist., vol. XII. 7th. series, 1903, p. 501) from Hirado in Western Japan in being obliquely ovate, but it is larger and lacks the radiating ribs of the latter.

Very frequent, especially at Koshiba where, however, the specimens occur in a much worn condition.

Fossil occurrence.—Miyata Zone (Harashita in Shimo-Miyata); Kanazawa Zone (Nojima); Koshiba Zone (Koshiba).

Living.—Central Japan (Sobo Peninsula).

220. **Pectunculus pilsbryi,** Yokoyama.

Pl. XVIII. Fig. 8.

Shell small, moderately solid, flatly convex, suborbicular, nearly equilateral, slightly longer than high, with anterior margin rounded and posterior subangulated in the middle. Surface with numerous, unequal, radiating riblets crossed by fine concentric impressed lines so that the riblets appear finely granulated. A fine interstitial riblet is also often present. Beaks small, pointed. Area very narrow, furnished with a few diverging lines. Teeth about twenty, vertical in the middle part of the hinge-line, oblique towards both sides. Inner margin crenulate.

A few specimens. The largest, which is a left valve, measures 20 millim. in height, 22 millim. in length and 5,5 millim. in depth.

Fossil occurrence.—Miyata Zone (Mukaibatake in Shimo-Miyata, and Kami-Miyata). Upper Musashino of Kazusa.

Living.—Central Japan (Bōshū).

Family **Parallelodontidæ.**

Genus ***Parallelodon,*** Meek et Worthen.

221. **Parallelodon obliquatus,** Yokoyama.

Pl. XVII. Fig. 6. Pl. XVIII. Figs. 9–11.

Shell moderately thick, convex, equivalve, transversely and longly ovate with the narrower end directed anteriorly, strongly inequilateral, with the posterior side three times as long as the anterior; anterior margin rounded, posterior arcuate with the rounded postero-ventral corner somewhat produced; ventral margin straight or sometimes even slightly excavated. Surface somewhat depressed in the middle, radiately ribbed; ribs numerous, fine, unequal, a little flexuous, occasionally with a finer interstitial riblet which becomes obsolete towards the beak, crossed by incremental lines and a few concentric grooves. Beaks small, almost touching. Area narrow, with a few sharp diverging ridges. Dentition consists generally of three subhorizontal, parallel, transverse-

ly striated teeth in the posterior portion and two such in the anterior, with a few (mostly about four) crenular teeth behind the anterior horizontal ones which may be sometimes very indistint or obsolete; of the three posterior teeth, the middle one is the longest and the lower one the shortest. Inner surface with radiating lines. Proportion of length to height and thickness 100 : 53: 36. The largest specimen measures about 53 millim. in length. Rather rare.

This species has some resemblance to the one described by Smith as *Macrodon dalli* (Challenger Lamellibranchiata, pl. XVII, fig. 10) from off Kobe at 50 fathoms, although it is more oblique and possesses a somewhat different dentition.

Fossil occurrence.—Miyata Zone (Shimo-Miyata and Okine); Yokosuka Zone (Otsu); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living.—Northern and Central Japan (coasts of Sagami and Hitachi).

Family **Limopsidæ.**

Genus ***Limopsis***, Sassi.

222. **Limopsis auritoides**, Yokoyama.

Pl. XVIII. Figs. 12, 13.

One right and two left valves. The form is somewhat variable, but decidedly oblique and rounded ovate with the shell thick and solid. The surface is nearly smooth, only showing distant impressed radiating lines crossed by more or less distinct incremental ones. Beaks small but pointed, situated in the middle of the hinge-face. Ears small. Teeth rather coarse, sixteen to twenty-one, straight and vertical in the middle of the hinge-line, oblique and curved outward toward the sides. Ligamental area broadly triangular, the breadth of the base being more than twice the height, shallow. Inner surface with fine and close radiating lines most distinct near the mantle-line. Inner margin smooth and sharp.

The largest specimen (left valve) measures 18,5 millim. in height, 18 millim. in length and 6 millim. in depth.

This species strongly reminds of *Limopsis aurita* Brocchi (Conch. Foss. Subap., p. 485, pl. XI. fig. 9) from the Pliocene of Italy and England, from which it differs only in the greater size and a very broadly triangular ligamental pit. Perhaps a discovery of a greater number of specimens may reveal a closer relationship between the two.

Limopsis woodwardi A. Adams (Dunker, Ind Moll., p. 237, pl. XVI, figs. 5,6.) living in our seas is also closely allied to the present species. In fact, some of its specimens greatly resemble the latter in being more trigonally ovate than one figured by Dunker. But the more narrowly triangular pit and the radiating riblets of the surface easily distingnish it from the the fossil form.

Fossil occurrence.—Kanazawa Zone (Nojima).

223. **Limopsis tokaiensis,** Yokoyama.

Pl. XVIII. Figs. 14, 15, 16,

Limopsis tokaiensis. Yokoyama, Species of Limopsis found in the Neogene of Koshiba, Jour. Geol. Soc. Tokyo, vol. XVII, no. 205, Oct. 1910, p. 1, pl. IX, figs. 1–3, 5–7.

Limopsis tokaiensis var. elongata. Yokoyama, Ibid. p. 2, pl. IX, fig. 4.

Shell moderately thick, compressed, obliquely oblong, strongly inequilateral. Anterior margin rounded, passing insensibly into the arcuate ventral margin. Postero-dorsal margin sloping, more or less straight, hardly forming an angle with the rounded posterior margin. Postero-ventral angle mostly rounded, very rarly obtusely pointed. Surface with only distant radiating impressed lines, crossed by coarse irregular lines of growth. Inner surface with fine, dense, raised, radiating lines most distinct along the mantle-line. Hinge-line slightly bent, with about twenty teeth in full-grown specimens, vertical in the middle, oblique and curved outward toward the sides. Ears small and indistinct. Area rather wide, with a very broadly triangular, shallow ligamental pit, whose base is usually about three times as long as its height. In the middle of this pit, there is generally a space which is either somewhat deepened or bounded by two shallow grooves corresponding

to the two sides of a triangle having its apex in common with that of the whole pit Beaks very small and pointed. Inner margin smooth and sharp.

There is a considerable variation in shape and thickness. The shape, however, is in general oblong, though, in a specimen which I formerly called *var. elongata* (the figure is in the above cited journal), it is posteriorly somewhat pointed. Between these two forms, there are all sorts of gradations. If we consider the shell as an ellipse whose longer diameter is 10, then the shorter diameter varies between 8 and 7,6. The thickness of a complete shell is about one-half the longer diameter.

The largest specimen in our collection is about 30 millim. in its longer diameter.

This species shows a great resemblance to *Limopsis marionensis* Smith (Challenger Lamellibranchiata, p. 254, pl. XVIII, figs. 2, 2b) from the Indian Ocean; but the Japanese form has the anterior side below the hinge invariably a little more produced than Smith's. *Limopsis pelagica* Smith described in the same work as occurring in Japan is also closely related to ours, but the beak is more prominent, the shell less oblique and the posterior wing more conspicuous.

Very frequent, especially at Koshiba, Nojima and Kikkōsan.

Fossil occurrence.—Miyata Zone (Jinyaato in Kami-Miyata); Kamakura Zone (between Urago and Enokido); Kanazawa Zone (Kanazawa and Nojima); Koshiba Zone (Koshiba and Ofuna); Naganuma Zone (Kikkōsan and Naganuma).

Living.—Central Japan (rarely found near the coast of Bōshū).

223. **Limopsis crenata**, A. Adams.

Pl. XVIII. Figs, 17, 18.

Limopsis crenata. A. Adams, Descrip. Some Species Limopsis fr. Cumingian Collection, Proc. Zool. Soc, London, 1862, p. 230. Yokoyama, Species of Limopsis found in the Neogene of Koshiba, Jour. Geol. Soc. Tokyo, vol. XVII, no. 205, Oct. 1980, p. 3, pl. IX. figs. 8–11.

Shell small, rather thin, convex, oblique, roundly ovate to oblong, nearly as high as long, anterior margin rounded, posterior

sloping, ventral arcuate with the postero-ventral corner, also more or less rounded. Surface with numerous, course, unequal, elevated, concentric lines of growth crossed by fine, close, impressed, radiating lines which make them finely crenulate. There are also a few broad concentric grooves on the surface. Beaks small and acute. Hinge-line arcuate with ten to fifteen teeth. Ligamental pit triangular, the height of the triangle being somewhat greater than the breadth of the base. Inner margin finely crenulate.

The form of the shell is somewhat variable, but may generally be said to be roughly oblong or elliptical, the longer axis being only a little longer than the shorter, with their proportion about 10 to 8,4. The thickness of a perfect shell is about two-thirds of the longer axis. The largest specimen does not exceed 13 millim. by 11 millim.

This species is readily distinguished from the preceding by its smaller size, a more tumid and less oblique shell and the crenulate inner margin.

Frequent in the Miyata Zone.

Fossil occurrence.—Miyata Zone (Yamagayado, Iwaiguchi, Jinyaato, Shishiana and Matsubara in Kami-Miyata; Harashita and Motoyashiki in Shimo-Miyata); Kamakura Zone (Kewaizaka in Kamakura); Kanazawa Zone (Nojima); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living.—Northern and Central Japan.

225. **Limopsis azumana**, Yokoyama.

Pl. XVIII. Figs. 19, 20, 21.

Limopsis azumana. Yokoyama, Species of Limopsis found in the Neogene of Koshiba, Jour. Geol. Soc. Tokyo, vol. XVII, no. 205, Oct. 1910, p. 3, pl. IX, figs. 16-18.

Limopsis truncata. Yokoyama, Ibid. p. 4, pl. IX, figs. 13, 14.

Shell small, generally moderate in thickness, tolerably inflated, oblique, ovate to oval, the height nearly equal to, or somewhat greater than, the length, very inequilateral, the posterior margin broadly rounded and passing gradually into the more sharply rounded ventral margin, the anterior margin generally

broadly rounded, but sometimes straight and truncate, or even slightly excavated. Surface with fine close radiating impressed lines crossed by concentric striae of growth. Beaks small and acute. Ligamental pit broadly triangular with the breadth of the base greater (up to twice) than the height. Teeth usually more than ten and up to fifteen. Inner margin smooth and sharp. The largest specimen measures 12,5 millim. in height. The proportions of the three dimensions, height, length and thickness, are 10, 10–8.8, 6.6–5.5.

This species is very variable in shape, especially in the shape of the anterior margin which, as above said, is sometimes even concave, instead of being convex. Such forms I formerly separated as a new species under the name of *Limopsis truncata*, but as I am now convinced, they are only abnormal forms of *Limopsis azumana*.

Not rare, especially at Koshiba.

Fossil occurrence.—Miyata Zone (Motoyashiki in Shimo-Miyata); Koshiba Zone (Koshiba). Upper Musashino of Kazusa and Shimosa.

226. **Limopsis adamsiana**, Yokoyama.

Pl. XIX. Figs. 1, 2.

Only two right valves. They are small, solid, compressed, roundly trigonal, nearly equilateral, slightly longer than high. The anterior as well as the posterior margin is rounded, the anterior somewhat more sharply than the posterior. The ventral margin is broadly arcuate. The surface is water-worn but seems to have been ornamented with radiating lines. Beaks small and pointed. The hinge-line is bent, with about five teeth in the anterior half and about six in the posterior. Ligamental pit triangular, somewhat broader than high. The anterior as well as the posterior muscular impression is bounded by an elevated ridge on the inner side, the posterior being much more elevated than the anterior one. Inner surface with fine close radial lines near the mantle-line. Inner margin smooth.

One of the specimens measures 8,2 millim. in length, 7,8 millim. in height and 2,2 millim. in depth while the other measures 7 millim. in length, 6,8 millim. in height and 2,2 millim. in depth.

In my paper on the "Species of Limopsis found in the Neogene of Koshiba" (Jour. Geol. Soc. Tokyo, vol. XVII, no. 205, 1910), I described this species simply as *Limopsis sp.*, questioning, whether it is not *L. Forskalli* Adams (Proc. Zool. Soc. Lond., 1862) from Oshima and Takanoshima, but as the latter is without figures and said to possess unequal riblets, I deem it advisable to describe the present species as a new one.

Fossil occurrence.—Miyata Zone (Kami-Miyata); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Family **Ledidæ.**

Genus ***Leda***, Schumacher.

227. **Leda ramsayi**, Smith.

Pl. XIX. Fig. 3.

Leda ramsayi. Smith, Report on the Lamellibranchiata, Challenger Expedition, p. 241, pl. XX, fig. 3, 3a.

Two left valves.

The shell is small, rather thin, compressed, transversely elongated, strongly inequilateral, the anterior margin sharply rounded, the posterior produced, rostrated and truncate at the end. The ventral margin is broadly rounded, straight or even slightly concave near the posterior end. On the surface there are two ridges running from the beak to the upper and lower corner of the truncated posterior margin. The sculpture consists of strong concentric striae which are suddenly turned upward and nearly at right angles on the flat or slightly concave space between the two ridges. The area is concave, smooth and sharply bounded by the upper ridges of the two valves. On the inner side of the rostrate end there is a short transverse median ridge. The teeth are numerous, close-set, the anterior row being decidedly shorter than the posterior which occupies about two-thirds the

length of the posterior side. The one valve measures about 9 millim. in length, 5 millim. in height and 1,5 millim. in depth, while the other measures 8 millim. in length, 4,5 millim. in height and about 1,5 millim. in depth.

This species agrees almost exactly with the one described by Smith under the above name, the only difference being a slightly shorter shell and a less excavated posterior part of the ventral margin in the Japanese specimens.

Fossil occurrence.—Miyata Zone (Motowada); Koshiba Zone (Koshiba). Upper Musashino of Kazusa.

Living.—Off Sydney, New South Wales, in 950 fathoms (Smith).

228. **Leda gordonis**, Yokoyama.

Pl. XIX. Figs. 4, 5.

Shell small, rather solid, moderately compressed, transversely elongated, inequilateral, the anterior side being somewhat shorter than the posterior. Anterior margin sharply rounded; posterior margin very obliquely truncate, forming an acutely pointed angle with the weakly concave postero-dorsal margin; the ventral margin arcuate, forming a very obtuse angle with the truncated posterior margin. Surface with two radiating ridges, the one running to the acute upper corner of the posterior margin and sharp, the other going to the lower corner of the same margin and very obtuse, the surface between the two being slightly concave. The sculpture consists of numerous fine concentric grooves, much narrower than the interspaces and making the latter appear like rounded riblets. Beaks small, obtusely pointed. Lunula broad-lanceolate, indistinct. Area long-lanceolate, sharply bounded by the upper radiating ridges of the surface and sublongitudinally striated. Teeth small, numerous, the anterior row about as long as the posterior which occupies about four-sevenths, of the posterior side. Pallial sinus rather deep, finger-like, somewhat obliquely ascending. Length 12 millim.; height 6 millim.; thickness 4 millim.

Rare.

This species resembles *Leda confusa* Hanley (Sowerby, Thesar. Conch., vol. III, Nuculidae, p. 119, pl. 228, fig. 85) living in our seas; but it is smaller, more solid, longer, more inequilateral, with the lunula not so sharply bounded and the pallial sinus more ascending and more uniform in breadth.

Fossil occurrence.—Naganuma Zone (Naganuma).

229. **Leda naganumana**, Yokoyama.

Pl. XIX. Fig. 6.

Shell thin, transversely elongate-ovate, tolerably compressed, slightly inequilateral, the anterior side being shorter than the posterior. Anterior margin sharply rounded, the posterior obtusely pointed; antero-dorsal margin weakly convex, the postero-dorsal weakly concave. Ventral margin broadly arcuate, going over to the posterior without any distinct angle. On the surface there is a single sharp keel running from the beak to the posterior angle and forming the boundary of the lanceolate area with pouting lips. The sculpture consists only of coarse unequal lines of growth. Lunula lanceolate, distinct, with the lips pouting like those of the area. The surface of the lunula as well as of the area is furnished with sublongitudinal striations. Length about 19 millim.; height 9,5 millim.; thickness 5 millim.

There is only a single example whose valves are closely attached to each other, on which account it is not possible to make out the characters of the inner surface.

This species looks like *Leda pernula* Müller (Sowerby, Thes. Conch., vol. III, Nuculidae, p. 113, no. 14, pl. 228, fig. 56–88) in which, however, the shell is more inequilateral, the lunula obsolete and the posterior end truncate.

Fossil occurrence.—Naganuma Zone (Naganuma).

Family Nuculidæ.

Genus *Nucula*, Lamarck.

230. Nucula insignis, Gould.

Pl. XIX. Figs. 7, 8.

Nucula insignis. Gould, Otia Conchologica, p. 175. Tokunaga, Foss. Env. Tokyo, p. 56.

One right and one left valve; the former 9 millim. and the latter 8 millim. in length. These are to be identified with the species above named occurring in great numbers in the Upper Musashino of the neighbourhood of Tokyo, and which may be described as follows:

Shell small, rather solid, obliquely ovate-triangular, convex, very inequilateral, posterior side very short and obliquely truncate at margin, with the postero-ventral junction subangulate, posterior side very long, more than four times that of the anterior, sharply rounded at end, ventral margin broadly arcuate. The sculpture consists of numerous rounded riblets, broader than the interspaces diverging from the median line of the shell to both sides; these riblets often also bifurcate near the ventral margin, giving rise to several inverted v-shaped figures. Beaks small, but prominent. Area cordate, bounded by obtuse ridges running from the beaks to the postero-ventral corners, with the lips somewhat pouting and the surface ornamented with diverging riblets like those of the other part of the surface. Ligamental pit obliquely triangular. Hinge bent, the anterior teeth about twenty, occupying a little more than two-thirds the length of the posterior hinge-line and generally curved outward, the posterior teeth about ten, also generally curved outward and often knee-shaped. Inner margin smooth. The largest shell attains about 15 millim. in length, 12 millim. in height and 8 millim. in thickness.

Fossil occurrence.—Koshiba Zone (Koshiba); Upper Musashino of Musashi, Shimosa and Kazusa.

Living.—Northern Japan (north of 37° N. Lat.)

231. **Nucula mirabilis,** Adams et Reeve.

Pl. XIX. Fig. 9.

Nucula mirabilis. Adams and Reeve, Zool. Voy. Samarang, Mollusca, p. 75, pl. XXI, fig. 8. Tokunaga, Foss. Env. Tokyo, p. 56.

Nucula cobboldiae. Brauns, Geol. Envir. Tokio p. 46. (non Sowerby).

This is a species which not only resembles the preceding but also to the English Crag species *Nucula cobboldiae* Sow. (Wood, Crag Moll., Bivalves, p. 82 pl. X, fig. 9), so that Brauns took it for the same species. Compared with the latter, there is no difference at all in its surface sculpture of divaricating and zigzag striae. In full grown specimens of the Japanese fossil, the line from which the striae (or riblets) diverge is approximately in the median line of the shell as in the English fossil. The zigzag striae are close in front of the median line, near the middle portion of the ventral and the posterior margin, and also sometimes in other parts, especially near the ventral margin. The size attained by full grown specimens is also nearly the same, the largest Japanese shell being about 30 millim in largest diameter. The number of teeth in the latter is about twenty-five in the anterior row and about ten in the posterior, so that the anterior has somewhat more teeth than the English species. But the main differences between the two are the presence of a shallow depression running from the beak to the ventral margin just behind the posterior margin and the more oblique and elongated form of the ligamental pit in the Japanese species. Moreover, the inner margin of the latter, though smooth on a cursory view, is finely and irregularly crenulated, a character which is not found in the English form.

Compared with *Nucula insignis*, *Nucula mirabilis* grows larger, with the area more sharply bounded and the inner margin very finely crenulate.

The fossil specimens in our possession are very few and broken. Therefore, taking measurements from a nearly perfect specimen obtained from the Upper Musashino of Shinagawa, we got the following dimensions: Largest diameter 30 millim., smallest diameter 22 millim., thickness 17 millim.; height or length of area 11,5 millim., breadth of the same 9 millim.

A specimen figured by Adams and Reeve seems not to be a full grown specimen. The posterior depression is not clearly shown in it.

Fossil occurrence.—Kanazawa Zone (Nojima); Naganuma Zone (Naganuma); Upper Musashino, of Musashi.

Living.—Central and Western Japan.

232. **Nucula tokyoensis**, Yokoyama.

Pl. XIX. Figs. 10, 11.

Shell small, moderately thick, convex, obliquely subtrigonal, inequilateral; anterior margin sharply rounded, posterior truncated, with the postero-ventral corner subangulate, ventral margin arcuate. Surface concentrically and unequally grooved, with grooves generally small and fine, crossed by fine radiating striae. Area longly cordate, defined by blunt but distinct edges, transversely wrinkled, the wrinkles not quite reaching the edges and somewhat bent towards the beaks so that there is a narrow unwrinkled space left along the edges. Lunula indistinctly developed, lanceolate and also transversely wrinkled. Teeth about twenty in the anterior row and about ten in the posterior. Ligamental spoon oblique, triangular. Inner margin crenulate. Larger diameter 8 millim., smaller 7 millim., thickness 6 millim.

Rare

Fossil occurrence.—Miyata Zone (Jinya-ato in Kami-Miyata); Naganuma Zone (Naganuma).

Subkingdom **Molluscoidea.**

Class **Brachiopoda.**

Family **Terebratulidæ.**

Genus ***Terebratulina***, d'Orbigny.

233. **Terebratulina crossii**, Davidson.

Pl. XIX. Figs. 12, 13, 14.

Terebratulina crossii. Davidson, Monogr. Rec. Brach., Trans. Linn. Soc. (2), vol. IV, p. 33, pl. III, figs. 4–6. Yokoyama, Some Brach. fr. Neogene of Koshiba, Jour. Geol. Soc. Tokyo, vol. XVII, no. 201, June, 1910, p. 1, pl. V, figs. 1–3.

This species is fully described in the above cited work of Davidson. In general the shell is ovate in form, longer than wide, with valves almost equally convex. The surface-sculpture consists of very fine radiating striae which in our water-worn specimens are hardly distinguishable except with a lens.

The specimens are very frequent at Koshiba being found in hundreds, but are mostly more or less distorted, so that it is very difficult to obtain a perfect and undistorted specimen. Nevertheless, we can discern a great variation occurring in their outline. According to the measurements given by Davidson, the proportions of length to breadth are 10 to 8. Among our fossils a more elongated shape predominates, so that the length is to the breadth as 10 to about 7,3. But there are specimens which are more like those figured by Davidson. The thickness of the shell is somewhat less than one-half the length.

In general the fossil forms seem to be somewhat smaller than the living, for none of them exceed 40 millim. in length, while Davidson figures one of 50 millim.

Fossil occurrence.—Kanazawa Zone (Kanazawa); Koshiba Zone (Koshiba); Naganuma Zone (Naganuma).

Living.—Central and Western Japan. Davidson states that the species lives between 100 and 250 fathoms.

234. **Terebratulina caput-serpentis**, (Linné).

Pl. XIX. Figs. 15, 16, 17, 18.

Terebratulina caput-serpentis. Davidson, Monogr. Rec. Brach., p. 17, pl. III, ffg. 12, pl. IV. figs. 1–11, pl. V, figs. 32–34. Seguenza, Pal. Malac. dei Ter. Terz. del Dist. di Messina, p. 44. Wood, Crag Moll., Bivalves, p. 169, pl. XI, fig. 3. Nyst, Conch. Terz. Tert. de la Belgique, p. 250, pl. XXVIII, fig. 3. Brauns, Geol. Env. Tokio, p. 74.

Anomia caput-serpentis. Linné, Syst. Nat. ed. 12, vol. I. p. 1153.

This is the species which I formerly took for *Terebratulina cailleti* Crosse (Jour. Geol. Soc. Tokyo, vol. XVII, no 201, p. 2) but which as I am now convinced, is nothing else than the cosmoplitan species of *Terebratulina, T. caput-serpentis* L. Our specimens agree most with the so-called variety *mediterranea.* Of about six specimens which we possess, the perfect and undistorted ones

show a distinct median sinus, a character wanting in the nearly related *T. japonica* (Sow.) Davidson (l. c. p. 34, pl. III, fig. 7–11). From *T. cailleti*, our species is distinguished by somewhat finer riblets. The most perfect example which is in our possession measures 15,5 millim. in length, 12 millim. in breadth and 8 millim. in thickners. Another specimen which is smaller measures 11 millim. in length 9 millim. in breadth and 5 millim. in thickness.

Fossil occurrence in Japan.—Miyata Zone (Jinya-ato in Kami-Miyata); Koshiba zone (Koshiba).

Fossil occurrence in foreign countries.—English Crag (Coralline), Scaldisien of Belgium, Pliocene of Italy, Greece. Madeira and the Azores, Miocene of Dax in France and of Turin in Italy.

Living.—Japan (according to Davidson): Northern Pacific; Northern America; Atlantic; Mediterranean.

235. **Terebratulina quantoensis,** Yokoyama.

Pl. XIX. Figs. 19, 20, 21, 22, 23, 24.

Terebratulina quantoensis Yokoyama, Brach. fr. Neogene of Koshiba, l. c., p., 2, pl. v, figs. 4–9.

The shell is ovate to pentagonal, somewhat longer than wide, the widest part lying a little posterior to its middle. The valves are unequally convex, the ventral valve being more convex than the dorsal and slightly flattened longitudinally along its median line. The foramen is large, oblique, incomplete, margined anteriorly by the beak of the dorsal valve and two small discontinuous deltidial plates. The sculpture consists of numerous radiating riblets which augment in number by bifurcation and also by the interpolation of shorter riblets between the longer ones. Incremental lines distinct.

On account of the difficulty of bringing the loop into view, the generic name is only provisional.

There is a great variation in the shape of the shell, as is common in this group of animals. Taking its length as 10, the breadth varies between 8.2 and 8.6, while its thickness is between 4.4 and 5. The largest example measures about 35 millim. in length.

The number of riblets may be generally taken at about sixty at the anterior margin, though in a small specimen 15 millim. in length, only fifty have been counted.

A species which most resembles this one is *Terebratulina caput serpentis* var *unguiculata* Dav. (l. c. p. 25, pl. v, figs. 38-40) from which the Japanese fossil differs in being generally broader, with the broadest part somewhat posterior to the middle of the shell.

Rather frequent, but mostly distorted.

Fossil occurrence.—Koshiba Zone (Koshiba).

Genus ***Terebratella***, d'Orbigny.

236. **Terebratella coreanica,** (Adams et Reeve).

Pl. XIX. Figs. 25, 28.

Terebratella coreanica. Davidson, Monogr. Rec. Brach., p. 81, pl. XIII, figs, 3-9. Dall, Amer. Jour. Conch., vol. VI, p. 121. Dunker, Index Moll., p. 252. Pilsbry, Cat. Moll. Jap., p. 151.

Terebratula coreanica. Adams and Reeve, Voy. Samarang, p. 71. pl. XXI, fig. 3. Schrenck, Moll. Amurl. u. d. nordjap. Meeres, p. 168. Lischke, Jap, Meeresconch., vol. I, p. 181.

There are two specimens. The one (fig. 28) has the shell large, longitudinally oval, swollen, longer than wider, widest about the middle. The dorsal and ventral valves are unequally convex, the dorsal valve being less convex than the ventral; the convexity of the dorsal valve is uniform and flattish, except near the anterior margin where it is very slight; the ventral valve has a strong longitudinal fold which, without any distinct boundaries, slopes to, and passess into, the lateral sides. Beak of ventral valve incurved, obliquely truncated by a large foramen, incompletely bordered in front by a separate deltidium. Surface smooth, only with lines of growth. Shell-structure finely punctate. Length 45 millim., breadth 40 millim., thickness 23 millim. It is no doubt an elongated form of the species above mentioned which is remarkably variable in shape.

The other (fig. 25) is a somewhat imperfect specimen with the ventral valve firmly attached to a stone, while the dorsal valve has fortunately been isolated from the same. It is a roundly pentagonal variety. The dorsal valve is nearly 30 millim. in

length and shows a longitudinal median depression which becomes nearly flat near the anterior end. The ventral valve is deeper than the dorsal one and shows a strong longitudinal rounded keel. The original orange-red colour is preserved as a light yellowish-brown tint.

Fossil occurrence.—Miyata Zone (Harashita in Shimo-Miyata (fig. 25) and Kami-Miyata (fig. 28). Upper Musashino of Kazusa.

Living.—Northern, Central and Western Japan.

236. **Terebratella pulvinata,** (Gould).

Pl. XIX. Fig. 26.

Terebratella pulvinata. Davidson, Rec. Brach., p. 90, pl. XVI, fig. 15. Carpenter, Check-List West Coast N. American Shells, 1860. Dall, Amer. Journ. Conch., vol. VI, p. 117.

Terebratula (Waldheimia) pulvinata. Gould, Otia Conch., pp. 97 and 255.

A somewhat broken specimen, 14 millim. long, 13,5 millim. broad and 7 millim. thick. It is rather orbicular, widest posteriorly and tapering anteriorly, with lateral and front margins rounded. The convexity of the dorsal and ventral valves is nearly equal and regular. The beak is small, with a round foramen bounded below by a deltitium. The surface, when examind with a lens, is tessellated with numerous fine, elongated dots arranged more or less in a quincunx, a character which Gould also observed in his specimens. The whole shell still shows a pale yellowish tint which may be due to its having been originally coloured by a similar hue.

Fossil occurrence.—Miyata Zone (Harashita in Shimo-Miyata). Upper Musashino of Kazusa.

Living.—Puget Sound, Washington.

238. **Terebratella nipponensis,** Yokoyama.

Pl. XIX. Fig. 27.

Terebratella nipponensis. Yokoyama, Brach. fr. Neog. of Koshiba, Jour. Geol. Soc. Tokyo, vol. XVII, no. 201, p. 3, pl. v, figs. 13-16.

A single specimen.

Shell small, tumid, somewhat squarely oblong, longer than wide, lateral margins only slightly rounded and nearly parallel,

anterior margin almost straight with its corners rounded. The dorsal and ventral valves are almost equally and regularly convex, without any signs of a longitudinal fold; beak of ventral valve short, a little curved, obliquely truncated by a foramen margined anteriorly by two small deltidial plates. Surface smooth; shell-structure finely punctate. Length 10 millim., breadth 7 millim., thickness 6 millim.

The general outline of this shell is like that of *Terebratella septata* Phil. (Seguenza, Memoria della Societa Italiana di Sciense Naturali vol. I, pl. VII, figs, 1,3) from the Pliocene of Italy and also of *Terebratella Mariae* Dav. (Monogr. Rec. Brach., pl. XV, fig. 13) living in our seas, but both of these have the ventral valve more convex than the dorsal and also a strongly marked longitudinal fold.

Fossil occurrence.—Koshiba Zone (Koshiba).

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INDEX.

Errata.

Page	77,	line	14.	Read	Polinices	instead of	Pollinices.
„	83,	„	24.	„	Fig. 18	„ „	Fig. 16.
„	84,	„	9.	„	„ 16	„ „	„ 18.
„	169,	„	9.	„	knee-shaped	„ „	knie-shaped.